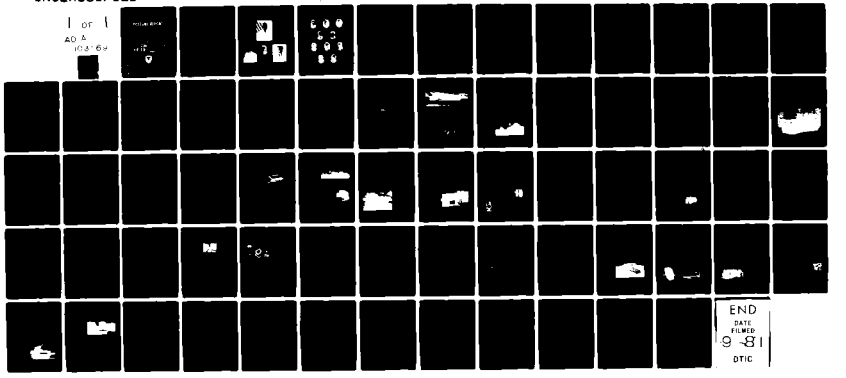
AD-A103 169 ARMY TANK-AUTOMOTIVE RESEARCH AND DEVELOPMENT COMMAND--ETC F/G 13/6
POSTURE REPORT.(U)
1980

UNCLASSIFIED NL



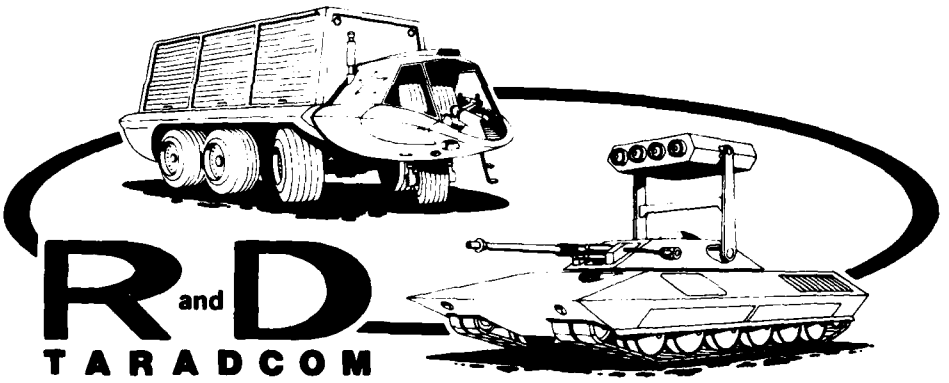
END
DATE FILMED
9-81
DTIC

(12)

FY 1980
ANNUAL LABORATORY
POSTURE REPORT.

~~RCS DRCLD-101~~

- ACCOMPLISHMENTS
- PROGRAMS
- MILESTONES



U.S. ARMY TANK-AUTOMOTIVE
RESEARCH AND DEVELOPMENT COMMAND
WARREN, MICHIGAN 48090

FOREWORD

The US Army Tank-Automotive Research and Development Command (TARADCOM) can be proud indeed of its last year (FY80) of achievements. It was during this landmark year that TARADCOM received the award as Most Improved Laboratory, U. S. Army.

Many of the management initiatives of FY78 and FY79 bore fruit, and the award for the Most Improved Laboratory, which was presented to TACOM by Dr. P. A. Pierre, Assistant Secretary of the Army, RD&A, became a reality. Competition for the award was between all Army Research and Development Commands and laboratory organizations.

As a continuation of the TARADCOM Laboratory improvement effort in FY80, TACOM's technical programs can be divided into three parts beginning in FY81.

(1) System projections involving the coordination of TRADOC and various DARCOM major subordinate commands in forecasting the need for new, conceptual systems and necessary improvements to existing equipment.

(2) System development demonstrating concept technologies through the use of test beds or prototypes.

(3) Supporting technology programs consisting of the detail subsystem and component development project aimed at providing the supporting lements required by target systems to meet forecasted needs.

During FY80, several coordination efforts were strengthened:

(1) The Tank Science and Technology (S & T) base was expanded to encompass all armored combat vehicles. The Armored Combat Vehicle S & T program monitors and coordinates more than 2,000 research projects related to armored vehicles at over a half-dozen commands.

(2) In the tactical vehicle area, a Tactical Wheeled Vehicle Management Office was formed which serves as the DARCOM focal point with TRADOC and DA for resolving the many bureaucratic log jams which in the past have blocked any motion toward resolving aging fleet problems.

(3) Designation of TARADCOM as the lead laboratory for devising a program for meeting DOD and DA goals in the field of mobility energy efficiency was established. This program, which will require extensive interface with MERADCOM and AVRADCOM, encompasses all Army vehicles, aircraft, and ground power units.

(4) Recognizing that the XM1 tank and the M2 and M3 fighting vehicle system are now moving to production, comprehensive planning for the 1990's for the next generation combat vehicle systems also was initiated.

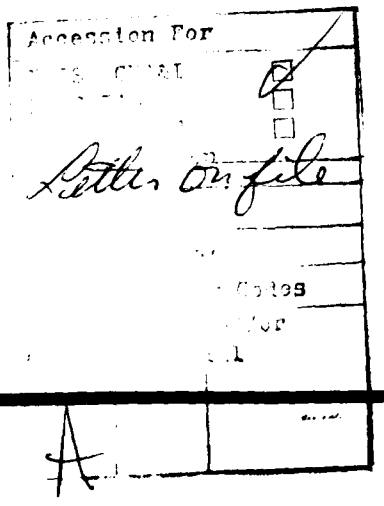
These coordination programs are particularly significant as points of application for the technology under development within DARCOM for the Rapid Deployment Force and main battle tank and infantry fighting vehicle follow-ons.

FY80 demonstrated considerable activity in the system development area. Significant accomplishments included Army approval for the deployment of the High Mobility Multipurpose Wheeled Vehicle to replace the aging M151 ¼-ton truck and the Heavy Expanded Mobility Tactical Truck to fill the much needed 10-ton capacity resupply and refuel missions.

Other activities included (1) type classifying the M939 5-ton truck; (2) initiating fielding of the M901 Improved TOW Vehicle, the M967 5000-gallon tanker, and the M871 22½-ton breakbulk container semitrailer; (3) designing, fabricating and delivery of 10 ARMVAL high mobility test vehicles for the Marine Corps, four XM999 semitrailers for the Ground Launched Cruise Missile, and two XM974 semitrailers for the Patriot Air Defense System; and (4) beginning of a compressed 33-month development program for the Fire Support Team Vehicle (FIST-V) and issuance of a request for proposal for the Field Artillery Ammunition Support Vehicle (FAASV).

The continuing TARADCOM program and improvement effort has resulted in a Tank-Automotive R & D Community which is a more viable and demonstrably significant DARCOM resource than at any other time during its long history.

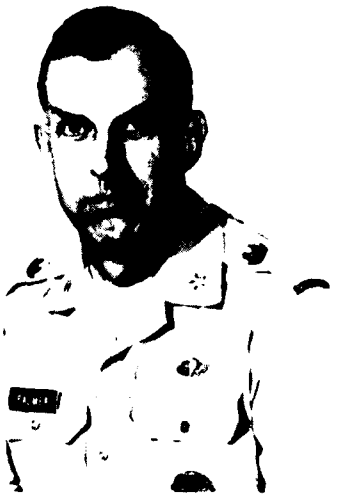
C. M. MATTHEWS, JR.
Brigadier General, USA
Deputy Commanding General
for Research and Development



command executive staff

BG Andrew H. Anderson
Commanding General

Col. John M. Pickarts
Deputy Commander



Col. W. T. Palmer
Chief of Staff

Dr. Ernest N. Petrick
Technical Director

command executive staff

Col. H. H. Dobbs
Director, Tank-Automotive
Systems Laboratory

LTC. T. H. Huber
Acting Director, Tank-Automotive
Concepts Laboratory

M. V. Tooley
Comptroller

Col. James A. Chernault
Project Manager
Improved TOW Vehicle

LTC. James B. Welsh
Product Manager, Armored Combat
Vehicle Technology

George Newcomb
Director, Engineering
Support Directorate

Douglas B. Munro
Director, Initial
Acquisition Directorate

Lowell Barnett
Director, Product
Assurance Directorate

Robert Swint
Chief, Integrated
Logistics Support Office

Joseph Nouse
Chief, Systems and
Cost Analysis Office

command organization chart

UNITED STATES ARMY TANK-AUTOMOTIVE RESEARCH AND DEVELOPMENT COMMAND

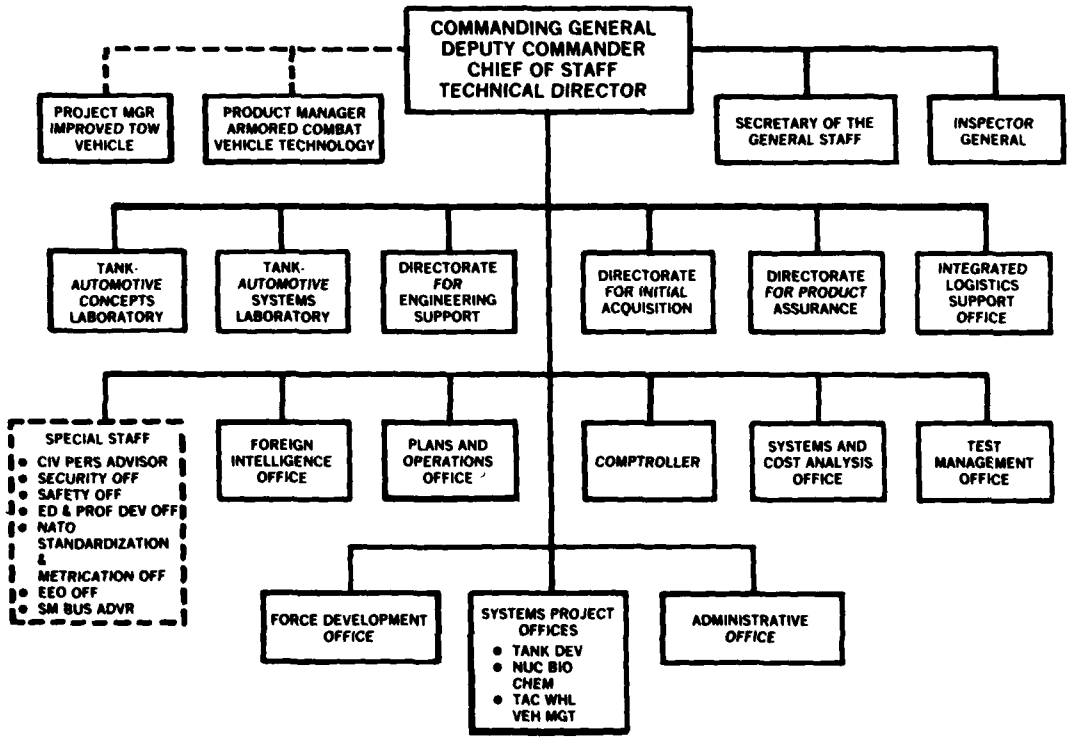


TABLE OF CONTENTS

EXECUTIVE SUMMARY

ORGANIZATION AND MISSION

Continuing its growth as a development command, TARADCOM, in FY80 restructured several organizations, added some key positions, and assumed several new missions. Highlights of the fiscal year include the following:

The Tactical Wheeled Vehicle Management Office, provisionally established late in FY79, was formally established and manpower spaces were provided by HQ DARCOM at the beginning of FY80.

The Computer Management and Applications Research Office was provisionally established during the third quarter of FY80. The primary mission of this new office is to serve as a principal staff element to advise and assist the Commanding General, TARADCOM, in planning and developing the information concepts, objectives, policies, projects, systems and methods relating to the procurement and use of ADP equipment (computers and peripherals) required for accomplishment of the TARADCOM mission. Currently the Computer Management and Applications Research Office is incorporated within the Combat Systems Division of TASL, but it is planned to break out as an independent office during the next fiscal year.

During FY80 TARADCOM was assigned as the lead agency in developing a fuel efficiency plan which will achieve the Army's goal of procuring mobility systems which are 15 percent more fuel efficient by the year 2000. TARADCOM has accepted the challenge and a plan of organization and execution was submitted to HQ DARCOM on 9 June 1980.

SUPPORT

During FY80 support was provided by a Comptroller; Initial Acquisition, Product Assurance, and Engineering Support directorates; and Inspector General, Foreign Intellegence, Plans and Operations, Force Development, Test Management, Administrative, Integrated Logistics and Systems and Cost Analysis Offices. FY80 accomplishments of these organizations are contained in the Augmented Laboratorory Posture Report (RCS-DRCLD-101) which is a substitute for the Annual Historical Review (RCS-CSHIS-6(R-3).

ORGANIZATION ASSIGNMENTS/RESPONSIBILITIES

TANK-AUTOMOTIVE CONCEPTS LABORATORY

The Tank-Automotive Concepts Laboratory (TACL) was established to focus management attention on advanced vehicle development programs, initiatives, and survivability. The TACL operated during FY80 with an organization structure consisting of an Exploratory Development Division, a Survivability Research Division, a Systems/Technology Integration Division, and a supporting Program Control Office. The Exploratory Development Division is responsible for advanced military vehicle system research, concept feasibility studies, and advanced engineering design programs, including the development of improved methods of assessing the effectiveness of future combat, transport, tactical, and special-purpose vehicle system designs; also the development and maintenance of tank-automotive long-range technology/methodology programs. The Survivability Research Division is responsible for basic and applied research directed toward new and improved vehicle performance, operational capability, survivability including research leading to new principles for sensing and measuring vehicle signatures and electromagnetic interference, counter-surveillance, signature reduction, electronic warfare countermeasures for military vehicle systems, and for exploratory development programs in ground mobility.

The Systems/Technology Integration Division was established to serve as the TARADCOM organizational point of contact for short-, mid-, and long-range R&D planning. The Division develops and coordinated technical planning policies, and provides centralized control and direction of the preparation and marketing of long-range vehicle systems and technology base plans. It also serves as the interface between the user community and DA agencies for identifying and developing combat vehicle systems technology to meet known or anticipated threats with new or improved vehicle systems.

TANK-AUTOMOTIVE SYSTEMS LABORATORY

Established on 1 Oct 77 to consolidate design, development, and engineering efforts for vehicle performance-related product improvement programs, the Tank-Automotive Systems Laboratory (TASL) is organized into three divisions (Combat Systems, Tactical Systems, and Propulsion Systems) and three separate supporting offices (Program Control, Tactical Wheeled Vehicle Management Office, and Computer Management and Application Research Office). During FY80 several organizational changes were implemented to consolidate activities and to accomodate changes in mission emphasis.

The Computer Management and Application Research Office has been established to consolidate TARADCOM's computer assets for control and function priorities. A new Systems Manager's Office was established for Combat Wheeled Vehicles and assigned under the Tactical Systems Division. The Field Artillery Ammunition Support Vehicle (FAASV) project was transitioned to the Combat Systems Division.

In addition to the assignments listed above, the Combat Systems Division conducts vehicle development, engineering development, and management of performance-related product improvements (PIs) for combat vehicles. The division also provides guidance for metallic component R&D efforts to include armor design, vulnerability, analysis, track and suspension, fire control integration, and fire survivability for combat tracked vehicles and the compilation and exchange of technical data with foreign countries under government policies.

Tactical Systems Division assignments include vehicle development, engineering development, and management of performance-related product improvement programs for tactical vehicles. The division also provides guidance for nonmetallic component R&D efforts.

The Propulsion Systems Division responsibilities include design, development, qualification, and integration of combat and tactical vehicle

engines, transmissions, diagnostic and prognostic equipment, and electrical power distribution and management systems. The compilation and exchange of technical data with U.S.-based industry is also provided.

The Program Control Office has the mission for providing budget and program support services to the Systems Laboratory and for administering the TARADCOM cost reduction, military adaptation of commercial items (MACI), and manufacturing methods and technology (MM&T) programs.

The Tactical Wheeled Vehicle Management Office provides improved control and cost-effective management of the Army's Tactical Wheeled Vehicle Fleet.

PRODUCT MANAGER - ARMORED COMBAT VEHICLE TECHNOLOGY

The Product Manager - Armored Combat Vehicle Technology (PM-ACVT) Office is responsible for planning, directing, and controlling the research, design, and development efforts for the High Mobility/Agility Test Bed Vehicle (HIMAG) and High Survivability Test Vehicle - Lightweight (HSTV-L) systems under the overall program guidance and funding support of DA Systems Manager.

PROJECT MANAGER - IMPROVED TOW VEHICLE

This Project Manager manages the expedited development, procurement, fielding, and support of the Improved TOW (tube-launched optical tracked wire command-link-guided) vehicle systems. Major program emphasis is to provide armor protection to the TOW anti-tank missile system and crew within three years from project approval. This is to be accomplished by developing a new weapon station which integrated the TOW system and the M113A1 Armored Personnel Carrier (APC) with minimal change.

The Office also manages the expedited development, procurement, fielding and support of a Fire Support Team Vehicle (FISTV); putting the Ground Laser Locator Designator (GLLD) integrated in the ITV day/night optical system, Vehicle Positioning Equipment (VPE), and communications equipment under armor on the M113A1 baseline vehicle; and fielding this system.

PERSONNEL AND FISCAL RESOURCES

PERSONNEL

At the end of FY80, TARADCOM's on-board strength was 850, a 97.6% fill of the 871 authorized positions. In addition a total of 41 DARCOM interns and cooperative students were on-board. Over 58% of TARADCOM's workforce had an associated degree or better and another 18.1% had some college training.

PROFILE OF TOTAL TARADCOM WORKFORCE

DEGREE	NO. EMPLOYEES ON BOARD ( )*	AVERAGE AGE	AVERAGE YEARS SERVICE	% OF TOTAL
PHD	13	43.2	8.5	1.4
MASTERS	100	43.3	13.7	11.2
BACHELORS	358 (25)	41.6	14.8	40.2
ASSOCIATES	50 (10)	39.4	14.9	5.6
COLLEGE (no earned degree)	161 (1)	43.0	17.1	18.1
HIGH SCHOOL	187	36.9	12.2	21.0
LESS THAN 12TH GRADE	22	52.9	23.2	2.5
TOTAL	891 (41)	41.2	14.7	100.0

*( ) Number of interns and Co-op students on DARCOM spaces included in total figures.

Profile of Professional Scientific and Engineering Personnel*( )	DOCTORS				MASTERS				BACHELORS				OTHER			
	NO.	AVG AGE	AVG GR.	AVG YRS SVC	NO.	AVG AGE	AVG GR.	AVG YRS SVC	NO.	AVG AGE	AVG GR.	AVG YRS SVC	NO.	AVG AGE	AVG GR.	AVG YRS SVC
CIVILIAN	13	43 2	13 5	8 5	80 (4)	41 2	12 1	12 5	272 (20)	45 0	12 5	16 7	16 (10)	32 8	7 6	7 2
MILITARY	2	46 2	COL	23 4	21	38 9	LTC	15 6	13	32 2	CPT	9 2	3	28 5	2LT	6 8

*( ) Number of Interns/Co-op students on DARCOM spaces included in total figure

AGE DISTRIBUTION OF PROFESSIONAL SCIENTIFIC AND ENGINEERING PERSONNEL BY GRADE*

AGE GROUP	SES	15	14	13	12	11	9	7	4/5	TOTAL
20-24						1	2 (2)	6 (6)	12 (12)	21 (20)
25-29				4	13	7	6 (6)	4 (4)	1 (1)	35 (11)
30-34			1	17	18	6	1 (1)			43 (1)
35-39		2	14	26	23	1	1	1 (1)		68 (1)
40-44			8	14	7			1 (1)		30 (1)
45-49		1	10	13	13	3				40
50-54		6	17	22	9	1				55
55-59	1	4	7	31	12	1				56
60-64		2	2	10	12					26
65-69				4	1	1				6
70-74				1						1
TOTAL	1	15	59	142	108	21	10 (9)	12 (12)	13 (13)	381 (34)
% of GRADE	.3	3.9	15.5	37.4	28.3	5.5	2.6	3.1	3.4	100.0
AVERAGE AGE	58	52.6	47.3	47.6	43.4	36.3	27.5	26.6	21.9	43.7

*( ) INCLUDES DARCOM INTERNS/CO-OPS

FY80 FUNDING
FROM ALL SOURCES INCLUDING CUSTOMERS
(in Thousands)

RDT&E FUNDS		FY80 SUBTOTAL	TOTAL
6.1 Research		$ 1140	
6.2 Exploratory Development		15350	
6.3 Advanced Development 6.3A	$ 50127		
6.3B	9640	59767	
6.4 Engineering Development		13037	
6.5 Management and Support		8711	
RDT&E TOTAL			$98005
PAA FUNDS			
HQ			
DARCOM	92597		
OTHER		92597	
NON-DARCOM (Other Army)		971	
PAA TOTAL			93568
OMA FUNDS			
HQ			
DARCOM	6538		
OTHER	4978	11516	
NON-DARCOM (Other Army)		-	
NON-ARMY		-	
OMA TOTAL			11516
GRAND TOTAL			203089

The chart shows the funding posture for FY80. A total of $203.1 million was expended during this 12-month period. Of this amount, $98.0 million or 48% was RDT&E funded; $93.6 million or 46% was funded by the Army Procurement appropriation; and $11.5 million or 6% was provided by OMA.

OUTSIDE/INSIDE PROGRAM

The following chart addresses the outside/inside program ratio for the RDT&E, PAA, and OMA appropriations.

Outside support accounts for 55% of the total RDT&E Program. This represents a 5% increase from the prior fiscal year and reflects an acceptable balance between government workforce and contractor effort for RDT&E functions. This external support is indicative of a healthy interest by industry and others in TARADCOM's R&D programs. This interest is encouraged to retain a base of knowledgeable, expert sources to augment the Army's R&D in-house resources.

Materiel and service contracts account for 97% of the PAA appropriation.

The OMA appropriation is basically an in-house support function for the day-to-day workload of the Command. Contractual requirements to support this program are minimal.

FY80
OUTSIDE/INSIDE PROGRAM
(in Thousands)

EFFORT / RDT&E FUNDS	Industry and Academia Contract/Total Expend		Other DARCOM Labs Contract/Total Expend		Other Government Agencies Contract/Total Expend		Estimated Cost To Administer	
	$K	$K	%	$K	$K	%	$K	%
6.1	345		15		30			
	1140	30	1140	1	1140	3	18	2
6.2	7681		1391		103			
	15350	50	15350	9	15350	1	454	3
6.3	33098		12926		8231			
	59767	55	59767	22	59767	14	2181	4
6.4	7942		3739					
	13037	61	13037	29	13037		70	1
6.5	1296							
	1730	75	1730		1730		9	
6.7								
RDT&E TOTAL	50362		18071		8364			
	91024	55	91024	20	91024	9	2732	3
PROCUREMENT FUNDS								
DARCOM	89710		608		971			
	92597	97	92597	7	92597	1	926	1
NON-DARCOM (Other Army)								
NON-ARMY	971							
	971	100	971		971		10	1
PAA TOTAL	90681		608		971			
	93568	97	93568	6	93568	1	936	1
OMA FUNDS								
DARCOM	350		480		2			
	11516	3	11516	4	11516	0	0	
NON-DARCOM (Other Army)								
NON-ARMY								
OMA TOTAL	350		480		2			
	11516	3	11516	4	11516	0	0	
GRAND TOTAL	141393		19159		9337			
	196108	72	196108	10	196108	5	3668	2

TANK AND AUTOMOTIVE TECHNOLOGY FUNDING

The following chart constitutes the funding breakouts for TARADCOM's Single Program Element Funding for the various efforts constituting AH91 is subject to change based both on higher level guidance and the Commander's flexibility to redirect funds into areas which present higher potential payoff.

TANK & AUTOMOTIVE TECHNOLOGY FUNDING

	FY80	FY81	FY82
MOBILITY			
ADVANCED PROPULSION			
Adv Adiabatic Tech	276	600	550
Eng Concepts - Non-Pet Fuel	0	600	1000
Adv Pwr Train Comp	0	0	600
Adv Air Filtration	0	300	1000
Adv Turbine	314	250	521
Eng Anal/Study Comp	0	0	500
Advanced Concept Team	677		
ACVT	208		
ADVANCED TRACK & SUSPENSION			
Exp Hdwe-Lt & Med Wt Veh	1448	1250	1400
ADVANCED ARMOR COMPONENTS			
Adv Comp Matl & Struct	392	200	275
Hi Strength Matl & Struct	135	50	200
SYSTEMS INTEGRATION			
TECHNOLOGY EXPLOITATION			
Comb Veh Sys Integ	148	685	550
Comb Veh Support	200	300	350
TACL Concept Support	64	200	300
TASL Systems Support	49	400	600
NATO Cooperative Act	150	170	200
Veh Effectiveness Tech	0	650	645
TGSM/Mine Sub-Model	100	200	0

TANK & AUTOMOTIVE TECHNOLOGY FUNDING (Continued)

	FY80	FY81	FY82
Data Acq & Veh Simulation	218	0	600
Chassis Weapon Interaction	0	0	136
CONFUGURATION CONCEPTS			
CADE	350	500	550
WASP Development	586	0	0
Future Veh Systems	700	1000	1200
Land Navigation Integ	550	427	600
Auto Loader	400	0	0
Weapon Station Integ	577	350	600
SURVIVABILITY			
REDUCTION OF DETECTION			
Reduction of Dust Signature	0	0	300
Secure Lighting	0	0	300
Veh Image Control	0	0	120
AVOIDANCE			
Adv Countermeasures	779	1100	650
REDUCED VULNERABILITY			
FIS-COV System Integ	473	675	700
Fire Det/Supp System	329	500	300
Compartmenting (Hyd & Fuel)	104	150	0
NBC Technology	100	200	400
Adv Armor Matl App	447	800	670
Compartmenting	345	0	225
Veh Hardening Tech	300	0	0
Direct Energy Beam Reduction	0	0	500
SUPPORT			
KRC Maint Support	139	150	200
Wheeled Veh Exploration	92	200	350
ATEPS Technology	223	250	150
Adv Diagnostics/Prognostics	572	550	400
Run Flat Tire	50		
Tactical ATEPS	13	0	200
Steel Banded Tire	70	0	0
Winterization Technology	0	0	325
Tactical Veh Concepts	263	0	0
Battery Life Extension	80	0	0
EPA/DOT Noise Abatement	100	0	0
MERADCOM	131	0	0
TOTAL	12152	12707	18167

NOTEWORTHY TECHNICAL CONTRIBUTIONS

ADIABATIC DIESEL ENGINE

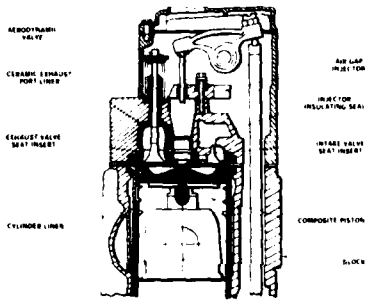
The objective of the adiabatic diesel engine program is to apply high-temperature, insulating materials within the combustion system of a diesel engine, thus allowing a drastic reduction in lost heat to the cooling and exhaust systems. Through the use of turbocompounding, thermal energy normally lost to the cooling water and exhaust gas is converted to useful work.

As a result of preliminary multicylinder performance evlauation, the adiabatic engine has demonstrated that it is currently the most fuel efficient engine in the world.

Successful elimination of the engine cooling system, including cooling fans, radiators, hoses and shrouds, would improve reliability and maintainability. The engine would not be sensitive to conventional cooling system damage and extreme environmental conditions. There would be approximately a 30 percent improvement in fuel economy which translate into increased vehicle range and reduced logistic concern. Specific weight reductions allow improved vehicle response, while a projected reduction allow improved vehicle response, while a projected reduction on installation volume of 40% will allow reduced armor cover requirements and improved survivability characteristics.

Because of high temperature engine operation, smoother combustion and improved multifuel characteristics result. With this engine concept, the entire philosophy of combat vehicle design becomes far less restrictive as the need for locating cooling grilles, passages, and associated equipment are eliminated. Engine cost is expected to be equal or less that its cooled counterpart.

Noteworthy accomplishments included successful operation of a hot pressed silicon nitride piston cap in an engine for over 450 hours at an equivalent peak pressure loading condition of 29 tons.



CROSS SECTION OF ADIABATIC DIESEL ENGINE

Various ceramic piston caps have been successfully run over 1100 hours in an engine environmen. High temperature lubrication package development continued with over 600 hours on a multicylinder engine test rig accumulated to date.

During FY80, preliminary single-cylinder optimization neared completion with final areas of emphasis involving the cylinder liner and head. A hot pressed silicon nitride piston was successfully run over 450 hours in an engine at full load conditions (or at an equivalent peak pressure loading condition of 29 tons). Various ceramic piston caps were successfully run over 1100 hours in an engine environment.

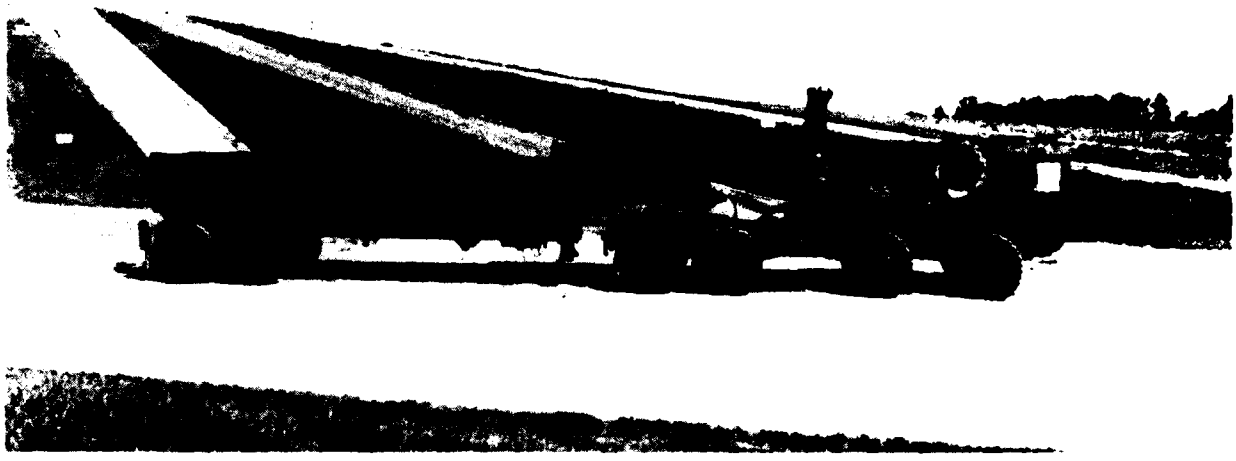
The turbocompound system to be used during multicylinder feasiblilty demonstration accumulated an additional 1000 hours of successful operation. High-temperature lubrication package development continued with over 600 hours on a multicylinder engine test rig accumulated to date. Multicylinder engine feasibility demonstration continued with initial performance results extremely encouraging.

Preliminary baseline performance of the adiabatic demonstrator engine include a brake specific fuel consumption of 0.285 BSFC at 440 HP. This level of fuel consumption is approximately 30 percent better than current highly efficient diesel engines and has never been matched by any vehicular engine anywhere in the world.

The adiabatic engine program entered an advanced prototype development phase in October 80, including both dynamometer and durability evaluations, and limited vehicle test rig experience.

GROUND LAUNCH CRUISE MISSILE PROGRAM - (GLCM - XM986 & XM999)

The Fire Ground Launch Cruise Missile (GLCM) Transporter prototypes to be towed by 10-ton heavy expanded mobility tractors (HEMTT) were delivered in FY80 for a durability testing. An XM999 Launch Control Center (LCC) preproduction prototype was delivered in late FY80 and an XM986 Transporter Erector Launcher (TEL) preproduction prototype is scheduled for delivery in early FY81 for subsequent system tests.



GLCM Transporter

A second major effort directed at achieving a production contract award will be initiated in FY81 and initial deliveries are scheduled to begin in mid-FY82.

In FY79, TARADCOM completed the design and fabrication of one pilot "A" trailer, a first generation GLCM transporter to be towed by the standard military 5-ton tractor. As a result of Pilot "A" tests, revised system loads and a revised mobility operating scenario, a second generation GLCM transporter was designed to be towed by the HEMTT. Fabrication of seven prototypes was initiated in late FY79 consisting of four pilot vehicles, one durability test vehicle and two preproduction prototypes (PPP), a TEL, and a LCC.

The GLCM is an Air Force Program chartered by DOD under the Joint Cruise Missiles Project Office, Washington, D. C.

TARADCOM was selected in late 1978 to be an associate GLCM contractor for design and development of two transporters: The TEL and the LCC. This effort also encompassed fabrication of prototypes and pilot vehicles, generation of mobility data and participation in an advisory capacity for design of all GLCM mobile equipment.

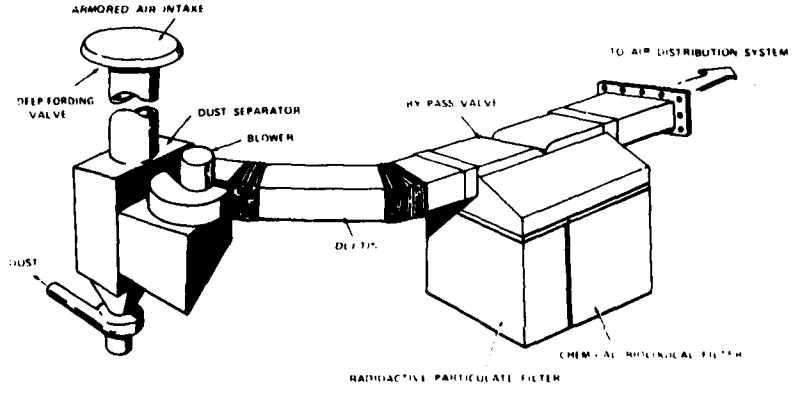
NBC PROTECTION
Hybrid Collective Protective Equipment

The commitment to develop Hybrid Collective Protective Equipment (HCPE) has culminated in the signing of a contract on 15 July 1980 for full scale engineering development. Delivery of 36 preproduction prototypes for specific vehicle (FAAR, US ROLAND, XM-1) engineering tests is projected to start in mid-FY82.

This new component represents a departure from established philosophy in nuclear, biological, and chemical (NBC) protection and an advancement in the state-of-the-art for US armored vehicles.

Information on the development of a positive pressure type protective system for combat vehicles gleaned from the FY79 Data Gap Program as to the feasibility of overpressure, vis-a-vis occasional open-hatch battlefield tactics, substantiated in earlier investigations conducted

HYBRID COLLECTIVE PROTECTIVE UNIT



in FY78, and gave impetus to the concept of modularized, hybrid collective protective system for combat vehicle, combining the unrestricted environment of the overpressure system with the flexibility of ventilated facepiece protection.

NBC Agent Resistant Paint

As a further enhancement to chemical warfare protection, chemical agent restraint paints are being seriously considered for application on the interior and exterior of all combat vehicles. This will allow much simpler decontamination procedures (i.e. soap and washdown) in lieu of the presently used corrosive DS-2 solution.

For the interiors of combat vehicles, two-component epoxy coating systems are being recommended. The epoxy paints cannot be used for final overcoat on vehicle exteriors due to their breakdown with loss of chemical agent resistance properties under extended periods of exposure to sunlight. The US Army is presently testing the more sophisticated and expensive two-component polyurethane coating system. Present indications are that it will meet Army requirements.

Contractors/sub-contracts will require physical demonstration/instruction and assurance by government specialists to demonstrate the simplicity of applying two-component agent resistant coatings versus presently used alkyd coatings. Such a demonstration is being conducted at Tooele Army Depot in the Fall of 80 under the auspices of the Development Project Office for Vehicle NBC Protection.

AUTOMATIC OPTICAL FIRE DETECTION AND SUPPRESSION SYSTEM

During FY80, prototype optical fire sensors and standard control electronic amplifiers were received. These will be used to snuff out a fire in a combat vehicle faster than the eye can blink. Final preparations were completed for laboratory environmental and performance testing during FY80 for performance testing scheduled to be conducted during FY81.

The optical fire sensor system is designed to detect explosions or fires within armored personnel carriers, discriminate as to the type or intensity of the blaze to avoid false alarms, and automatically actuate the fire extinguisher to put out the fire.

Major draft specifications for the sensor systems have been coordinated and are being updated into final form.

FIRST MANNED TETHER FREE FLIGHTS OF WASP II

WASP II is a small one-man, kinesthetically controlled individual mobility device developing its lifting force from a modified cruise missile engine, which can be operated by non-aviation rated military personnel.

Technical feasibility of Williams Arial Systems Platform (WASP) II was demonstrated on 17 Apr 80 by the first manned tether free operation at Walled Lake, MI. To date, 18 tether free operations have been performed successfully with the vehicle attaining speeds of 40-45 mph at an altitude of 60 feet and up to five and a half minutes in duration. This vehicle has calculated capabilities of speeds up to 65 mph, 4,000 feet in altitude for 20 minutes in duration.

The past 12 months of effort has resulted in the fabrication of two WASP II vehicles.

All test flights were performed with one of the vehicles and proceeded according to a rigid plan. First the vehicle was held by a gimbal

WASP II on its first tether free operation
17 April 1980

mechanism, allowing rotation motion only in order to check rotational stability. Next, it was flown in a tethered mode.

This high risk program was completed three months ahead of schedule and within budget. Currently plans are being formulated for a follow-up program to determine the military potential of the WASP II vehicle.

SIMPLIFIED TEST EQUIPMENT TRACKED VEHCILE

Simplified Test Equipment Tracked Vehicle (STE/T) currently is being adapted to support the IFV/CFV Fighting Vehicle System (FVS) vehicles. Delivery of units for FVS initial fielding is scheduled for FY82.

Upon completion of this program, STE/T will become the standard test system for all combat vehicles until the second generation system, Simplified Test Equipment/Expandable, STE/X), becomes available. The decision to apply STE/T to the XM1 resulted in the replacement of five XM1 peculiar test sets which has accelerated the Army program for standardization of multi-purpose test sets by at least 10 years. Five STE/T prototypes were developed with capability to support both the turret and the hull, including the AGT 1500 turbine engine. The system was successfully demonstrated in mid-80. Thirty-one STE/T sets have been procured for the XM1 during DT/OT III beginning in Sep 80.

The STE/T program to expand the STE/ICE concept to turrets to support the XM1 and FVS vehicles resulted in development of two additional modules, a Controllable Interface Box (CIB), and a Set Communicator (SET COM), which when combined with an expanded Simplified Test Equipment/Internal Combustion Engine (STE/ICE) becomes the core of the STE/T. The CIB enables the basic STE/ICE to address several hundred test points required to test the turret, and the SET COM provides an expanded communication link between the test set and the mechanic. In operation, the CIB provides the interface between the turret and the STE/ICE set, and the SET COM enables automated step by step instructions for the mechanic to perform test procedures to locate the fault.

ACOUSTICALLY BASED DETECTION OF AIRBORNE ANTI-ARMOR THREATS

During the past years, the technical feasibility of detecting and locating attack helicopters from a buttoned up combat vehicle was demonstrated. The concept uses technological advances in acoustic signal processing to passively detect, locate, and identify rotary wing aircraft with sufficient accuracy and range to give the combat vehicle and advantage in an engagement scenario.

Following successful laboratory demonstrations, a field test of the advanced breadboard hardware was performed during late Aug and early Sep 80. The test utilized the detection system mounted aboard the M60 tank to detect HH3-E helicopters operating alone and in multiples of two and three. The HH3-E was chosen because of its similarity to the Soviet HIMD-D in size, weight and configuration. The helicopters flew anti-armor scenarios against the M60 operating alone with other M60's and M113A1's.

Preliminary measurements indicate that detection ranges sufficient to detect, locate, identify, and counter aircraft carrying antiarmor missiles are achieveable from onboard operating combat vehicles. The system shows particular promise as a means for passive identification friend or foe (IFF) and beyond-the-line-of-sight detection of helicopters.

An effort is also in progress to utilize the elevation and azimuth information available from the system to lay a crew served weapon on or near the threat. An M60 stabilization system has been modified to provide the electro-hydraulic interface with the microprocessor out put of the threat detection system.

RESOURCES SAVINGS/VALUE ENGINEERING

For the first time in its history, the TARADOM Value Engineering (VE) program met all three of its goals in FY80. They included 25 value engineering proposals (VEPs), three value engineering change proposals (VECPs), and a savings of $2.00M. Actual accomplishments were 31 VEPs and 5 VECPs, and a savings of $2½ million.

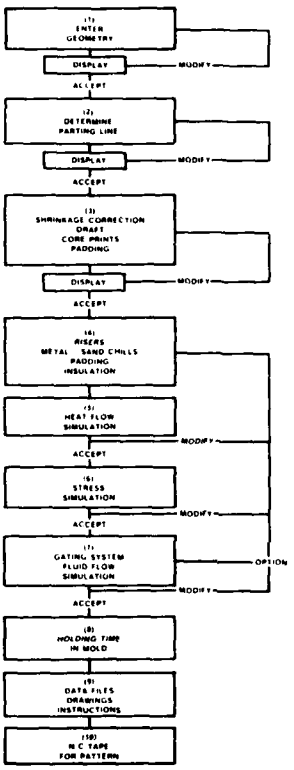
Some of the validated programs are:

IMPROVED FOUNDRY CASTINGS PROGRAM

With the goal of reducing scrap losses, TARADCOM launched a program to develop computer aided design and manufacturing (CAD/CAM) techniques for casting. The computer software will help designers locate gates and risers and determine final mold design via three-dimensional graphic displays, heat flow, fluid flow, and stress analysis of the casting process. The design sequence will be followed to insure casting soundness. The software system will be available to production foundries.

COST-EFFECTIVE MACHINING TECHNOLOGY

Contract work has been in progress, beginning in FY80, to establish the most cost-efficient machining parameters for metals with unique qualities to tracked combat vehicles. Previously, no machining data has been recorded or tabulated on these metals, and it is on these materials that the contractor is running machining tests. In addition, the contractor is extracting data from troublesome production parts which will assist production contractors and provide additional material for the special machinability data book.



Abbreviated Flow Diagram for CAD/CAM Casting Process

INTEGRALLY CAST LOW-COST COMPRESSOR

The integrally cast compression program is designed to cast the first, second, and fifth stage low-pressure compressor wheels on the AGT-1500 turbine engine. This program has the potential to reduce overall engine costs by $5000 per engine.

Studies have been completed on the fifth compressor stage. The final casting of the fifth stage will be submitted to TACOM in second quarter FY81 for engine testing. The first and second stages are currently undergoing investment casting/tooling construction.

UPSCALING ADVANCED POWDER METALLURGY PROCESSES

Powder metallurgy has been tested for the production of high performance gears. The ability to produce fully dense parts with properties equivalent to wrought material and net or near-net shape translates into minimized machining costs and reduced processing costs through energy conservation. The process chosen is forging of powder metal preforms. This hard tooling approach defines the product shape. Interchangeable inserts will be used to minimize die costs by allowing the die to accept standard size inserts. Thus, a family of gear sizes may be forged by simply changing the punch/insert combination, while utilizing the same basic die set and ejection system.

MANUFACTURING TECHNIQUES FOR TURBINE ENGINE RECUPERATOR

The Manufacturing Techniques for Turbine Engine Recuperator program was initiated to improve the welding process used in the turbine engine recuperator and to reduce manufacturing costs. The recuperator contains almost two miles of welding. New laser welding techniques have the potential to perform this welding six times faster than present resistance welding processes

Phase I of the program verified the laser as a viable method of joining Inconel 625 for the recuperator and verified that the system can produce an acceptable weld. The developed process will be faster and less expensive than the standard welding process. It is estimated that $1000 savings can be realized for each recuperator. A prototype laser welder is being purchased to verify the process in a production environment. If successful, a similar laser welding system could handle the entire production requirement for the XM1 AGT-1500 engine recuperator. By using the laser welding system, it is estimated an additional $2 million can be saved in capital investment. Reduction of health hazard from noxious welding fumes is another advantage.

MOLDED PLASTIC ORDNANCE ELECTRICAL CONNECTOR

Molded Plastic Ordnance Electrical Connector (MPOEC) project purpose is to develop an optional material to replace the current steel and aluminum ordnance electrical connectors with plastic molded connectors to eliminate corrosion problems and reduce weight and cost. Connectors were fabricated from thermo-plastic polyester "Valox 420" and successfully completed validation and laboratory testing. The new connectors are interchangeable, intermateable, and intermountable with the existing metal connectors. The field tests were conducted on 15 vehicles and the plastic connectors were intermounted with the steel receptacles at -65°F (-54°C) on M151 jeeps and on M113 personnel carriers in Alaska and at Yuma Proving Grounds on the M113, M60, M818 and M54 vehicles. The results show that after two years there have been no failures or deterioration of MPOEC's and they are a satisfactory replacement for the standard metal connector. All MPOEC's remain installed on those vehicles in their present locations and are subject to periodic observation. The MPOEC's are being implemented through the M113, M113PIP and FVS offices. The new drawings will allow the initiation of an ECP for MPOE connectors. This project offers savings in weight and cost.

ARMY GROUND TURBINE (AGT) 1500 FUEL ECONOMY PROGRAM

The Army Ground Turbine (AGT) 1500 Fuel Economy Program objective is to reduce the mission fuel consumption. This fuel economy improvement will be accomplished by decreasing the idle fuel flow, achieving the greatest percentage of fuel reduction in the 40-50 percent power range, and obtaining a mission-weighted 10 percent average reduction in specific fuel consumption throughout the engine operating range. Additional goals are improved RAM-D factors and reduced engine acquisition cost. During FY80 detail design of the engine was completed, and all hardware procured or fabricated for assembly of the first test engine in First Quarter FY81. The combustor test rig designed for the AGT-1500 combustion system, was completed and testing initiated. Component tests began on the high pressure compressor. Recuperator core testing was completed and design selection made.

Achievement of program objectives will result in extended range for the XM11 and/or reduced fuel supply logistics along with associated costs. Component evaluation is currently underway with engine performance evaluation scheduled during first quarter FY81.

1500 HP DIESEL ENGINE DEVELOPMENT

The 1500 horsepower diesel engine project, initiated in Mar 79, objective is to continue development of a diesel engine option until the Army Ground Turbine (AGT) 1500 has fully demonstrated satisfactory operation in the XM1 tank.

Improvements of the AVCR-1360 diesel are being pursued via development of variable area turbochargers (VATS) and variable speed cooling fans. The VATS have been fabricated and subjected to bench tests from which optimization of the turbine and compressor wheel profiles have been derived. Final wheel configurations are being fabricated for operation on engines beginning in mid-FY81.

The variable speed cooling fan system has been fabricated and is undergoing bench durability and control tests. Results indicate that design objectives are being achieved.

The second program phase, initiated in mid-FY80, provides for update and rebuild of two existing engines, laboratory development and durability tests, fabrication of two new engines, integration in two prototype XM1 vehicles and automotive test of the diesel powered vehicles. Preliminary layouts have been completed identifying the engine and vehicle changes required for integration and long lead items for the engine rebuilds have been ordered. Laboratory tests are scheduled to begin in May 81 and vehicle tests in Jul 81.

ADVANCED TECHNIQUES FOR ELECTRICAL POWER MANAGEMENT, CONTROL AND DISTRIBUTION SYSTEMS

Advanced Techniques for Electrical Power Management, Control, and Distrubtion Systems (ATEPS) is an advanced technology procedure which integrates all electrical power and information transfer within combat vehicles. It is a systems approach which integrates all electrical/electronic functions within the vehicle and includes built-in capabilities for diagnostics and prognostics. The system integration is achieved by using digital multiplexing with micro-computer control, integrated controls and displays and solid state power control switching. Communication between vehicle subsystems is accomplished by the Multiplex Data Bus.

ATEPS hull prototype hardware development was initiated, for installation and evaluation, in a baseline XM1 prototype in FY80. The hull task, with follow-on turret prototype hardware development, will establish the feasibility of the ATEPS system and allow for its consideration as an XM1 PIP and for other Army vehicle development programs. The ATEPS hull prototype hardware consists of a bus assembly (data and power), driver's crew terminal, bus controller/remote terminal, and three remote terminals. Installation and test in the XM1 prototype hull is planned for FY81.

Other accomplishments include five published reports describing the potential application of ATEPS to Army vehicles. Work also was initiated for the reduction of ATEPS system hardware to enhance its potential for XM1 PIP application.

AUXILIARY POWER UNIT FOR XM1/M60

Development continued on the Auxiliary Power Unit (APU) which supplies electrical power for application to the XM1/M60 tank systems. The APU is a gas turbine driven generator set capable of delivering 10KW of 28V DC power for low temperature starting of the main engine, silent watch, and maintaining vehicle batteries. Five prototypes were delivered and laboratory/vehicle tests initiated.

BLACKOUT LAMPS

A follow-on program to expand the application of the new light emitting diode (LED) lamps to military vehicles will begin in FY82. This entire program will result in a substantial savings in cost, size, weight, and power consumption compared to the incandescent lamps currently in use.

TARADCOM was tasked by Department of the Army (DA) to provide economical blackout units (markers, stop light, tail light and driving light) for application to the full range of commercial substitute tactical vehicles that the Army might buy in the future.

Laboratory and field tests revealed that the LED was ideally suited for blackout lamp application. Blackout tail, stop marker, and driving lights were completely designed. Twelve sets of LED prototypes were fabricated in-house, and evaluated in accordance with MIL-STD-1179.

Initial application of LED blackout lamps will be on the M876 telephone truck (288 units). A complete data package has been designed for the telephone truck blackout lamp fabrication and installation. This is currently being revised, prior to final approval. Adaptation to other vehicles will be by means of revising the telephone truck data package. The complete technical data package (TDP) will be finalized in FY81, and this action will constitute the completion of the DA task.

REDIRECTION OF EFFORT

2½ TON, 6 x 6, XM963 SERIES TRUCKS

At the beginning of FY80, the XM963 Series Program was in a phase-out category due to a lack of requirements for 2½ ton trucks until 1986 and beyond.

The phase-out period commenced in Sep 79 and was completed on 30 Jun 80. During this period limited component testing was conducted, three vehicles were updated and eight vehicles were assembled. The three vehicles became part of TARADCOM's test fleet and the eight vehicles shipped and stored at Letterkenny Army Depot.

The contractor furnished the total documentation that had been generated on the product improvement contracts plus any and all component hardware. This software and hardware is currently being stored locally.

Two of the test fleet vehicles have been loaned to TARADCOM's Propulsion Laboratory. This Laboratory is in the process of conducting feasibility development study by installing a different model transmission and transfer case assembly on both vehicles. Limited testing on these vehicles will be held locally during FY81.

It is estimated that six million dollars would be required to reactivate the 2½ Ton Product Improvement Program (PIP) for a period of two years. This would result in obtaining a Technical Data Package for production purposes. The 2½ ton tactical fleet would be modernized by infusion of PIP trucks, which include improved reliability, availability, and maintainability (RAM) and conformance to Federal Regulations on vehicles.

2-½ Ton PIP Truck XM963 Series

MANAGEMENT OF RESOURCES

6.1 BASIC RESEARCH

Work under "Research in Vehicular Mobility" was divided into three major thrust areas. "Applied Mobility Research", "Component Technology Research" and "Countermeasures Research".

Field tests were conducted to gather data concerning the off-road turning behavior of military tires. The data band is needed to develop a mathematical model of a wheeled vehicle turning in soft soil. A delayed measurement state estimation techniques has been developed and implemented. This will be used for enhancing our capability of designing improved weapon station control systems.

A three dimensional finite element analysis model of track pad has been developed and laboratory validation tests have been conducted. This work is expected to lead to improved track pad life.

A methodology has been developed for the determination and analysis of target and background interrelations and their effects on the infrared signatures of both static and dynamic vehicles. This research effort will yield results which will contribute to our ability of designing vehicles with reduced signatures.

IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

Fourteen research tasks were conducted under this program in FY80. The technology areas represented in this research ranged from the scanning photoacoustic microscopy to the study of powdered metal matrix composites. Eight of the tasks were newly initiated in FY80, with one being a joint laboratory ILIR task undertaken with the Engineer Topographic Laboratory (ETL). Several noteworthy technical achievements resulted from the program, which has also been a valuable tool for recruiting and retaining qualified scientists and engineers.

Scanning photoacoustic microscopy, a recently developed surface and near surfae nondestructive evaluation technique, fits well with the need for this type of flaw detection in the newly improved engineering ceramics. These ceramics are central to advanced engine programs because their high temperature capabilities will allow both higher operating temperatures and reduced cooling requirements for more efficient engines. These ceramics are still brittle, however, and their critical flaws are roughly an order of magnitude smaller than critical flaws in metals so that improved nondestructive evaluation is essential for their wide spread application.

The detection, recognition, and identification of potential threat targets is a crucial area of investigation for the survivability of US Army vehicles. Real time optical and digital correlation techniques provide important means for performing these surveillance/countersurveillance functions. The cross-correlation of a standard reference vehicle image with a potential target image is accomplished using conventional Fast Fourier Transform (FFT) algorithms.

A joint effort with ETL at Ft. Belvoir combines the results of their acoustic-optical Direct Electronic Fourier Transform (DEFT) device with a digital simulation of the same data that is obtained at TACOM using digital simulation. Analysis of the Fourier Transform properties of these images will establish a measure of effectiveness of vehicle survivability and guide the development of countersurveillance techniques.

Double exposure pulse holography is a new technique for studying the acoustic and vibrational characteristics of large vehicle structures. The holographic fringe data gives the design engineer detailed information about those regions on the vehicle that have a large displacement amplitude, areas of large stress concentration, positions of nodal and anti-nodal displacement and damping characteristics.

Excellent quality holograms have been taken of the M151 and M113 vehicles. Several holograms of the M151 engine were quite useful for predicting component fatigue. Significant progress was made toward perfecting techniques for taking holograms of very large structures, solving significant limitations of the ruby laser holocamera, establishing a methodology for the quantitative interpretation of holographic fringe data in terms of vibrational parameters.

6.2 EXPLORATORY DEVELOPMENT

In the diagnostic, prognostic, and electrical systems thrust area, a universal Controllable Interface Box (CIB) configuration was established which enabled expansion of STE/ICE to turret applications for XM1 and FVS vehicles. This effort enabled XM1 to provide all organizational maintenance test support with a single test systems replacing five special test systems. The system is currently called STE-XM1, but when it is adapted to the FVS vehicles, it will become Simplified Test Equipment-Tracked vehicle (STE-T) which will be the standard test system for all combat vehicles until the second generation system Simplified Test Equipment-Expandable (STE-X) becomes available. STE-X will have expansion capabilities to test all combat systems. A concept definition for STE-X has been completed and advanced development will begin in FY81.

In FY80, the Vehicle Monitor System (VMS) hard-

ware and software were modified to provide initial prognostic capability to start engine (electrical), ability to stop vehicle (brakes), cooling system performance and air filter performance. A new software program was written to enable APG to determine, by test, the prognostic potential of the STE/ICE diagnostic connector assembly on the FVS and M113A1 vehicles.

The Fire Detection and Suppression Technology Program objectives are to provide state-of-the-art fire detection and suppression componentry for existing and future combat vehicles. The program goals include (1) the investigation of foreign hardware, (2) exploitation of technological advances in the field of fire suppression, and (3) development of improved techniques and instrumentation to aid in component/vehicle integration. Laboratory test facilities were established in FY80 to perform the extensive testing required to evaluate new concepts. Israeli fire suppression hardware was acquired and will undergo evaluation beginning in late 1980. Exploitation of new fire suppression technology has been initiated with three competitive procurements: one for sensing systems with improved discrimination performance, one for extinguishing systems with improved reliability and reduced leakage, and one for fabrication of prototype hardware of a gas generator assisted expulsion system. This gas generator concept offers great promise for overcoming the problems associated with the current practice of superpressurization using dry nitrogen gas. Another effort beginning in 1980 is the development of a passive suppression system dedicated to the protection of hydraulic and fuel lines. In 1981 work will begin on the development of more sophisticated techniques and instrumentation for integration of modern fire suppression systems into combat vehicles. It is through this coordinated program of technology advancement, component evaluation and system integration that the full capabilities of state-of-the-art fire suppression technology will be realized.

The Passive Fire Protection for Hydraulic and Fuel Lines Program objective is to prove the feasibility of a passive fire suppression system for hydraulic and fuel lines. Unprotected lines are extremely vulnerable to rupture and ignition resulting in an explosive fire. Lines are particularly hazardous when located in an area outside the view of optical fire sensors. This system will provide fire suppressant jacketing which when ruptured will supply a suppressant cloud (probably a dry powder chemical agent suspended in a thisogelled HALON) precisely at the point of the rupture. The advantages of this approach are its ability to operate independent of the primary optical detection and suppression system, and the localized activation at the point of origin of the fire (successful suppression depends on attacking the flame front as soon as possible). During FY80, a contract was awarded for the design and fabrication of experimental hardware. During FY81 a realistic test procedure and baseline threat data will be developed with actual evaluation of the passible suppression system scheduled for mid-FY82.

The design of the ATEPS hull prototype hardware system was completed using the XM1 tank as a baseline. Fabrication of the hardware elements is in progress with a scheduled completion date of Nov FY81. Work was initiated for the size reduction of ATEPS system hardware to enhance its potential for XM1 PIP application.

Progress and accomplishments in FY80 included published second edition of close combat vehicle science and technology plan with all required coordination. The heavy adaptive payload study was completed. Participation took place in cooperative NATO/Army Arrangements Group Panel II programs on standardization of analytical techniques (Mobility and Armor), NATO track commonality, standardized scoring criteria for reliability estimation, and revision of NATO 400 hour engine test. NATO combat and technical data base for implementation of DARCOM's RSI guidance was developed. A program for automatically setting up a three-dimensional vehicle model has been developed. Software for standardized hybrid data storage and retrieval has been implemented. A procedure for predicting component failure based on strain gage data has been tested. A variety of armor composite configurations was evaluated to determine effectiveness to defeat various overhead threats.

An advanced tank configuration assessment was completed, and preparation for the award of a future close combat vehicle contracts for conceptual designs was finalized. Conceptual designs of XM1 derivative tank with external main gun were completed. The initial scope of work and cost estimates for a tank technology test bed (phase 1) was accomplished. Technical discussions with Sweden, Germany and the UK on future vehicle design, and research on future vehicle crew sizes and task assignments were initiated. A feasibility study relative to the application of fluidics to the gun stabilization system of the XM1 has been completed. As a result of the study findings, the development of a pneumatic rate sensor for direct gyro replacement has been undertaken. A position control system gunner's control handle has been developed and is presently in the test and evaluation phase. Participation in the development of the combat vehicle protion of the Army fire control planning guide provided opportunity to indicate TACOM support and direction toward development of the high potential technologies. Initial studies of vehicle firing stability for light fighting vehicles with high impulse guns were completed, and countermeasure versus threat trade off analysis to quantify the payoffs of countermeasures for vehicle survivability were initiated. Inhouse and contractor feasibility studies were explored for preliminary automatic loading schemes.

6.3 ADVANCED DEVELOPMENT

A contract was awarded in FY80 for the initial installation and evaluation of ATEPS hull system in a baseline XM1 tank. The contractual task includes the development, installation, and test of the ATEPS turret prototype hardware system.

MANAGEMENT IMPROVEMENTS

COMMAND MANAGEMENT INFORMATION SYSTEM (CMIS)

CMIS is a management information system which provides the tools necessary for proper project planning and control. It provides timely and accurate visability of project milestones and cost status to enable all levels of management to efficiently allocate resources and apply emphasis where necessary.

During FY80, many extended efforts were performed to automate CMIS. The Datapoint 1500 Intelligent Terminal System was purchased and installed. Software programs for implementing CMIS reports are 80% complete. Programs which have been written include: CMISS2K File, System 2000 Input Program, and Datapoint Input Program. The program for the CMIS Report Generater is expected to be complete during the first quiarter of FY81, thus allowing CMIS reports to be prepared and extracted in an automated manner shortly thereafter. The Technical Elements Automated Planning System (TEAPS) has also become a part of CMIS. TEAPS is a standardized list of all current and planned projects in the command. It serves as a management tool and planned funding document.

SCHEDULE MANAGEMENT SUPPORT

Schedule management support is being provided to the TARADCOM Systems Managers for several programs. This support includes PERT network analysis, GANTT chart preparation and plotting and Independent Evaluation Plan (IEP) review. Systems for which support was provided are the High Mobility Multi-Purpose Wheeled Vehicle (HMMWV), 10 Ton M.A.N. Truck, M939 5 Ton Truck PIP, Small Unit Support Vehicle (SUSV) and Heavy Expanded Mobility Tactical Truck (HEMTT).

VEHICLE TECHNICAL DATA BASE

A vehicle technical data base is being developed for use in providing characteristic and performance data for U.S. and foreign combat and tactical vehicles. The data base structure is complete and work is in progress on the data entry software.

TEST INTERACTIVE MANAGEMENT

The Test Interactive Management System (TIMS) is a computerized file which provides TARCOM/TARADCOM/PMOs with information concerning critical event milestones and the status of all development and operational tests, as well as production, laboratory, and contractor testing. As a result of a FY77 data user survey, the number of parameters (or fields) in the computer program were tripled, thus allowing for reporting on a larger number of critical milestones and providing for more in-depth information. These listings were provided to an expanded list of customers. Emphasis is continuing to be placed on obtaining real-time data in the overall program.

LIGHT ARMORED VEHICLE PROGRAM

The Wheeled Combat Vehicle Office, established in Jul 80 to support the Marine Corps-Light Armored Vehicle (LAV) Program, will fill interim critical Marine Corps needs for improving infantry mobility and fire power. The initial procurement objective is to evaluate and select and "off-the-shelf" system upon which mission variants can be developed. Multiple contracts will be awarded for a performance and operational suitability competitive evaluation to be conducted in FY81. One competitor will be selected for the production contract.

TACTICAL WHEELED VEHICLE MANAGEMENT OFFICE

The Tactical Wheeled Vehicle Managment Office (TWVMO) became fully staffed and operational during the third quarter FY80. TWVMO's mission is to create and maintain overall fleet development, product improvement, acquisition, maintenance and replacement planning to provide a balanced economical and effective tactical wheeled vehicle fleet. TWVMO also coordinates interchange requirements from other commands and product developers as well as military inter-departmental requests from other services. TWVMO currently is involved in the Tactical Wheeled Vehicle Zero Base Study, Vehicle Useful Life Studies, and Impact of Commercialization of the Logistics Support System.

INTERNATIONAL TECHNOLOGY EXCHANGE

The principal mechanism for technological communication within the NATO community for tank-automotive equipment is the Combat and Support Vehicles AC 225 Panel II. TARADCOM designated a Technical Director to monitor international activities with its International Technology Exchange Function providing support to the NATO activity as well as to similar activities under the Quadripartite Agreement, International Memoranda of Understanding & Data Exchange Agreements, to exchange technical data.

The current strength of TACOM assigned technical project officers (TPOs) is 16 and 27 assistant technical project officers (ATOPs). In FY80, they have maintained communication with foreign counterparts concerning TARADCOM activities. The Annual Data Exchange Agreement (DEA) Report, relating to the 16 DEAs under responsibility to TARADCOM TPOs was prepared and forwarded to DARCOM. The report presents the consolidated activity and status for each DEA during the past year (ending in July of each year).

The International Technology Office (ITO) was involved in 31 visits involving 98 visitors from various foreign countries on briefings such as: lab test facilities, advanced concepts, research and engineering, TOW, HSTV, M60, XM1, STE/ICE, quality assurance and the ROKIT program. These visits included notables from Korea, Japan, Israel, and several European countries.

ITO participates in equipment loans to foreign countries. One such item was a M113A1 Carrier Improved Cooling System Modification Kit, which was loaned to Canada for testing.

During the past year, TPOs and ATPOs visited France, Germany, Israel, Italy, Egypt, England and Australia under the ABCA Agreement. There were seven visits by TPOs and ATPOs during FY80 to European countries to exchange information under the auspices of Data Exchange Agreements.

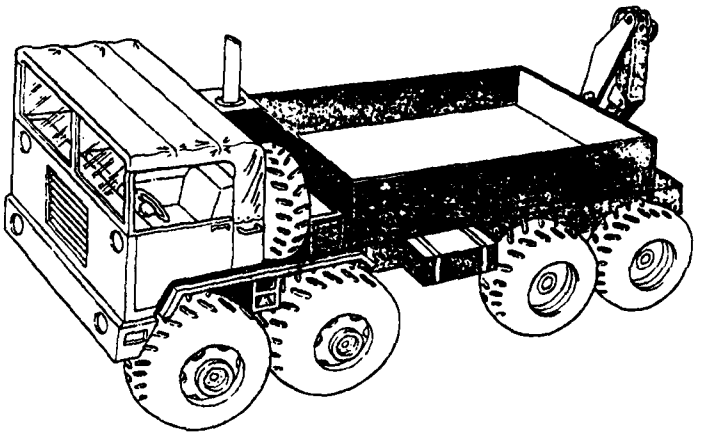
Foreign contractors for whom visits were arranged by the ITO represented companies of England, Sweden, Israel, and Germany.

ITO involvement in the information exchange with foreign governments is expanding and it is expected to result in an improved level of quality and standardization of US military equipment. A project which has been undertaken by the ITO is investigation of candidates, domestic, and foreign for a new combat engineer vehicle. This project was requested and funded by the Navy, for the Marine Corps. It will take approximately six months and will investigate vehicle characteristics to provide a comparison study from which a final condidate can be considered.

TANK-AUTOMOTIVE SYSTEMS LABORATORY

HEAVY EXPANDED MOBILITY TACTICAL TRUCK PROGRAM

The HEMTT Program was initiated to meet the heavy payload, expanded mobility mission needs in the ammunition resupply and refuel roles. Concept vehicle feasibility tests showed that this need could be best achieved by an 8 × 8, 10-11 ton payload system, composed of commercial components. The result was the evolution of a balanced tactical truck system, possessing excellent on and off roadability and utility at a reasonable cost. The Air Force Ground Launched Cruise Missile (GLCM) PMO requirements for off-road prime movers, generated the redesignation of the HEMTT required operational capability (ROC) as a joint service operational requirement (JSOR) document. The JSOR was approved by DA on 25 Oct 79 and by the Air Force on 18 Mar 80. The JSOR was approved by DA on 18 MAR 80. The JSOR includes vehicle requirements for: The Air Force GLCM PM, the PATRIOT Missile System PM, and Army artillery and armor resupply and recovery units.



10T-HEMTT

10-TON M.A.N.

Acquisition of M.A.N. trucks was set apart from the Heavy Expanded Mobility Tactical Truck (HEMTT) Program in order to fulfill the requirements of the Air Force Ground Launched Cruise Missile (GLCM) Program Manager (PM) and the Army Pershing II Missile System PM. These two systems will be deployed in Europe and will take advantage of the existing M.A.N. supply and maintenance network. Based upon the HEMTT Joint Services Operational Requirement and specific requirements of the GLCM and Pershing II PMs, a performance specification, defining two basic chassis configurations, an XM1001 tractor with either medium or heavy-duty crane and an XM1002 wrecker/recovery truck, was developed. The specification formed the basis for development of an acquisition package for a production contract which will be awarded in Oct 80. A total of 466 vehicles will be delivered, the first 15 of which will be utilized by the PMs for system testing.

5-TON PRODUCT IMPROVEMENT PROGRM XM939 SERIES TRUCKS

The DEVA IPR, held on 5 Sep 79, type classified 13 body styles of the XM939 Series and Standard LCC-A. HQ DA approved the type classification (TC) on 12 Oct 79. With the type classification approval these still remained the issue of the House Appropriation Committee (HAC) approving funds for production of M939 Series vehicles. The Department of Army wished to obtain funds to procure M939 Series vehicles; therefore, it was decided that possibly Dr. Pierre, Assistant Secretary of Army, should meet with Congressman Addabbo, HAC chairman.

In Dec 79, actions were taken to close-out the 5-Ton PIP program because of limited funds. The close-out was to continue for eight months (Mar thru 31 Oct 80). During the middle of the close-out period, Congressman Addabbo approved production of M939 Series vehicles using FY81 funds. With this approval, a production invitation for bid (IFB) was issued on 22 Aug with industry responses due 22 Oct 80. In support of the production contract, a System Technical Support (STS) request for quotation (RFP) was issued on 8 Sep 80 with responses due by 27 Oct 80.

Production of the 5-ton product improved M939 series truck results in modernizing the 5-ton

tactical fleet with improved reliability, availability, and maintainability (RAM). Modification includes an automatic transmission, higher torque capacity transfer case, full air brake system, three man cab, tilt fender and hood, and improved fifth wheel.

5-TON HIGH MOBILITY TACTICAL TRUCK

The 5-Ton High Mobility Tactical Truck (HMTT) participated in the Concept Evaluation Program (CEP) conducted by the US Army Infantry Board (USAIB) during Oct 79-Jan 80 at Ft. Benning, GA. The HMTT mobility was compared with the M561 (Gamma Goat) and with the M813A1 5-ton truck for materiel handling equipment capability. The data obtained will be used by the US Army Infantry School (USAIS) to prepare input to the final design package for interface equipment and to provide support for an overall position on materiel handling equipment. USAIB found that the HMTT is as mobile as the M561 (Gamma Goat) under the conditions tested. During the loading trials, USAIB found that the HMTT cargo bed is high, making it difficult to hand load and for the crane operator to see and operate the controls. It was also found that the crane took up much needed cargo space. The truck is at Keweenaw Research Center, Houghton, MI, for continuation of design modification and engineering evaluation and is scheduled for completion by Dec 80.

2-½ and 5 TON COMMERCIAL TRUCK

The 2-½ and 5 ton commercial truck market will continue to be surveyed to determine promising systems which will be evaluated for military application.

Patriot Missile Semitrailer

PATRIOT SEMITRAILERS

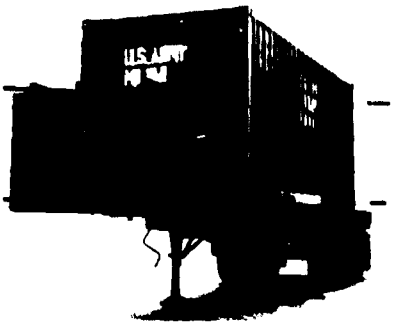
The Patriot Missile System is being provided design, development and production of two configurations of semitrailers:

(1) The XM860 which is a rigid mobile platform to transport either the radar or launcher units.

(2) The XM974 which is a dual purpose transporter for maintenance support. A production contract for the XM860 was awarded during FY80 for a three year buy of 203 units.

M871, TACTICAL, DUAL PURPOSE BREAKBULK/ CONTAINER TRANSPORTER, 22-½ TON

The M871 is a flatbed semitrailer, 30 feet long with tandem axle suspension, capable of transporting one 20, two 10, three 6-2/3, or four 5-foot long containers or breakbulk cargo weighing up to 22-½ tons, and is equipped with side racks for transporting breakbulk cargo. Over 300 vehicles have been produced. The M871 has completed the endurance test mileage of 12,000 each on three vehicles. The prime movers for the M871 are the M818 and the M915. The deployment of the M871 will commence in the second quarter of FY81.



M871 22-½ Ton Semitrailer

M857 SERIES 5000 GALLON SEMITRAILER

The M857 series vehicle is a 5000 gallon capacity fuel hauling and fuel servicing semitrailer consisting of three production models: M967 (Bulk Haul Self Load/Unload), M969 (Automotive Refueler), and M970 (Aircraft Refueler). It has been designed for use by the Army and Marine Corps to operate under all conditions. The prime movers are the M818 and M915. The vehicle is a replacement for the M131 series trailers. The M857 is a low profile semitrailer with a stainless steel single compartment tank that can be air transportable by the C-130 aircraft. The M857 5000 gallon semitrailer has been fielded. Production of 567 units for the Army has been completed as well as nine units for Portugal. The program transitioned to TARCOM on 30 Sep 80.

11-TON HEAVY EXPANDED MOBILITY AMMUNITION TRAILER

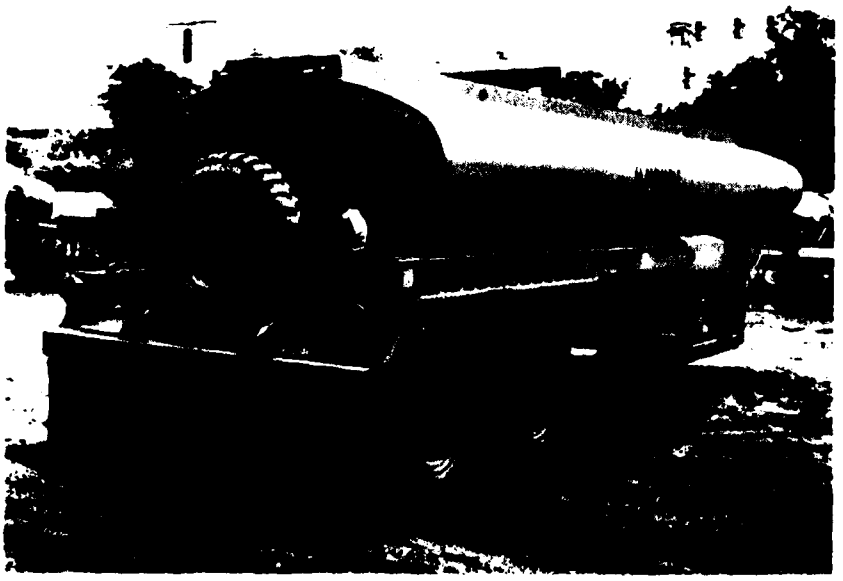
A draft specification for an 11-Ton Heavy Expanded Mobility Ammunition Trailer (HEMAT), XM989, has been completed. The trailer will be a non-development item (NDI) and is required by the MLRS Project Office.

HIGH MOBILITY MULTI-PURPOSE WHEELED VEHICLE

The High Mobility Multipurpose Wheeled Vehicle (HMMWV) will perform the mission of all ¼-1¼ vehicles presently operating in the forward area. The J-MENS, initiated in Jan 79 by TRADOC, was formally approved by the Secretary of Defense on 8 Jul 80; providing the HMMWV with formal program status. In the interim, a draft specification for the High Mobility Multipurpose Wheeled Vehicle was developed. Program direction, schedule, and conditions were established during the Special Tri-Service General Officer Review in Washington on 29 Jan 80. Upon joint mission element need statement (JMENS) approval, the Initial Acquisition Directorate released a Letter of Interest (LOI) with Draft Specification to industry. On 23 and 24 Sep 80, the HMMWV Office conducted an in process review (IPR) to prepare request for proposal (RFP) release.

ELECTRIC VEHICLES

An interagency agreement has been executed to provide for procurement of five electric vehicles. Red River Army Depot will demonstrate evaluate, and test the vehicles over a three year period.



M967 5000 Gallon Semitrailer

COMMERCIAL UTILITY AND CARGO VEHICLE

The Military Adoption of Commercial Items (MACI) Commercial Utility and Cargo Vehicle (CUCV) project will be developed to combine diesel, 4 × 4 and 4 × 2, cargo truck for payloads of ¾ ton to 1-¼ tons. These vehicles will replace part of the M151A2, ¼ ton truck and part of the M880/890 series cargo trucks. Applicable kits include winterization, arctic, machine gun, 24 volt electrical system with 60 and 100 amp capacity, troop seats, cargo box cover, and communication shelters. Other changes will include blackout lights; STE/ICE; nuclear,

biological and chemical (NBC); driver weapon security; and military towing provisions. The present objectives are to survey the various types of trucks in the ¾ to 1¼ ton payload range in the commercial market which will meet our performance requirements. The Required Operational Capability (ROC) document being developed by the Army Training and Doctrine Command is expected to be completed in Nov 80. Various ket applications will be developed during FY81.

COMMERCIAL MOTORCYCLES

The Commercial Motorcycle Project for limited reconnaissance (rear area liaison and messenger service) is under study, due to delays in user determination of helmet requirements.

SIMPLIFIED TEST EQUIPMENT FOR INTERNAL COMBUSTION ENGINES (STE/ICE)

STE/ICE replaces five separate items of test equipment at organizational level and additional testers at direct support level. STE/ICE diagnostic connectors are being installed in vehicles under development, including the 2½ and 5-ton PIP trucks, IFV, CFV, MLRS, XM1, FAMECE, UET, and Marine Corps LVT7A1.

Progress to date includes completion of engineering development, type-classification standard, and production contracts for 5500 sets. Initial Operational Capability (IOC) was achieved in Feb 79 at Ft. Bragg, NC, and European IOC was achieved in Oct 79.

Design to Unit Production Cost goals ($4,350 in FY75 dollars) have been exceeded in the Jul 80 procurement which was awarded with a $3,700 (FY80 unit cost). Reports from the field indicate high reliability.

The successful development and fielding of STE/ICE resulted in expansion of the STE/ICE concept to test entire combat vehicle systems, which resulted in the initiation of the Simplified Test Equipment-Tracked vehicle (STE/T) program.

SIMPLIFIED TEST EQUIPMENT-EXPANDABLE (STE/X)

STE/X is intended to provide the forward support combat vehicle mechanic with a simple and rapid means of diagnosing and assessing the condition of the total vehicle in its "as is" condition. The application includes automated tests of vehicle power packs, hull systems turret systems, communication systems, and on-vehicle missile systems. The STE/X will become the single standard test set for on-line diagnostics of all present combat vehicles including XM1 and IFV/CFV and will be readily expandable for application to future vehicle developments.

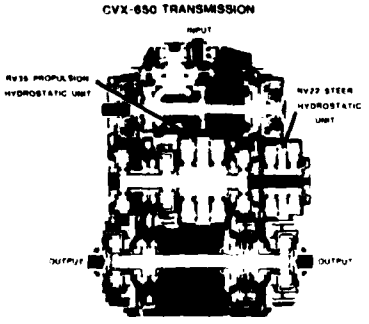
The system definition phase was completed in Sep 80. An initial draft Outline Acquisition Plan was distributed for coordination in July 80. Advanced development will begin early in FY81 followed by engineering development in FY82. The target initial operational capability date is Feb 85.

Preliminary STE/X Hardware

CVX-650 HYDROMECHANICAL TRANSMISSION

The CVX-650 Transmission Development Program represents a significant advancement in hydromechanical technology. Designed for tracked vehicles up to 25 tons and 650 HP, it incorporates several features that make this transmission an improvement over current hydromechanicals. (1) The propulsion and steering power paths are separate, improving transmission controllability. (2) Hydromechanical drive is effective in all ranges resulting in increased efficiency. Electronic controls are being used for precise speed ratio and steering control along with the additional benefit of an inherent diagnostic system. Design features will enable the continuously variable speed ratio characteristics of this transmission to control more effectively engine operation for fuel efficiency and performance.

The CVX-650 program has over the last 15 months completed the transmission design and drawing effort. Critical components were successfully tested allowing initiation of the transmission fabrication phase. Breadboard electronic control units were designed, built, and tested in a driver/vehicle/engine/transmission computer simulation program. Fiscal years 81 and 82 will see transmission assembly and extensive laboratory and in-vehicle testing of the two prototypes.



SELF-CLEANING AIR FILTER

TARADCOM established a program to develop a self-cleaning air filter (SCAF) system to clean engine induction air for the XM1 tank and other combat vehicles. The high concentration of dust under field conditions and the desire of user units to be free of frequent and lengthy maintenance procedures provided the impetus for this development.

Current military air filter specifications require 99.5 percent efficiency and 20-hours dust capacity (service life) under laboratory conditions. However, under severe field conditions, the service life can be reduced to less than two hours.

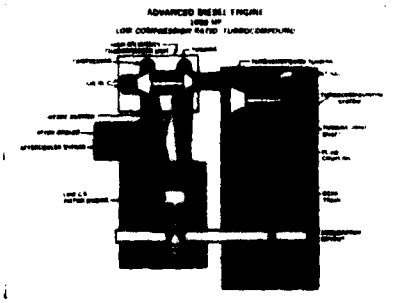
Goals of the self-cleaning air filter program are to provide air filtration within the same space allotment and at the same level of efficiency as in existing configurations, while extending service life by a factor of five.

During FY80, development tests on the prototype XM1 SCAF model were continued in the laboratory, including a 500 hour mechanical durability test. Improvements were made to the SCAF design as a result of tests. A new multi-year contract has been negotiated with the engineering contractor which will culminate in the installation and test of a SCAF unit on an XM1 tank in FY82.

1000 HP ADVANCED DIESEL ENGINE

The 1000 HP Advanced Diesel Engine Program objective is to demonstrate the feasibility of dramatically improving the diesel engines' horsepower to weight ratio and fuel economy by applying advanced diesel technology to existing commercial-base engines, with the goal of achieving 1000 horsepower. The advanced technology being applied includes a high pressure, high-efficiency turbocharger; turbocompound system; low-compression ratio, and an intake manifol burner to aid in cold starting and light-load operation.

TACOM is currently evaluating an advanced diesel engine test rig. This rig is a modified version of the Cummins VTA-903, 8 cylinder, 500 horsepower diesel that is to power the Army's new Infantry Fighting Vehicle. the test engine has operated successfully up to 850 HP at 3200 RPM with a brake specific fuel consumption (BSFC) of .400 lb per hp/hr. Through Jul 80 the test rig has accumulated 145 hours of total test time. Test rig engine testing will continue through FY81 with emphasis on the testing of a new advanced turbocharger, a special aftercooler, and an intake manifold burner. Materials and designs will be evaluated for fabricating a new high-strength piston.



ENGINE CONCEPTS FOR ALTERNATE FUELS

In FY80, Engine Concepts for Alternate Fuels group conducted in-house tests of a NTC Cummins engine with a shale fuel and of a Air-cooled "V" Diesel Supercharged (AVDS) 1790-2c engine using a fire resistant fuel. Contracts were let to test the AGT 1500 and an adiabatic single cylinder engine using shale fuel. The primary

effort in FY80 was devoted to:

(1) Establishing a technology base for development fuel insensitive and efficient engines.

(2) Drawing on the above technology base to develop modifications for engines in the field and under development, develop two engines families covering the range of 50 to 1000 HP and develop systems for engines over 1000 HP.

The US Energy Program precipitated by the current energy crisis will, in the late 1980s and 1990s, inflict a proliferation of alternative fuels on the Army fuel supply system. Maintaining mobility standards of current and future Army fleets has imposed a need for a new order of fuel efficient and fuel insensitive engines. To meet this need, a separate project, Engine Concepts and Development for Alternative Fuels, was created.

TURBINE COMBUSTION RESEARCH

Laboratory testing is in process to identify turbine engine combustion parameters for incorporation in a combustion model. This model will serve as a design guide for emission indices and combustion efficiencies. Various fuels including shale derived, alternate fuels are included in the combustion study.

TURBINE CERAMIC COATING COMPONENT

Ceramic coatings will improve turbine engine performance by providing component heat barriers allowing higher cycle temperatures with resultant efficiency increases. Baseline testing and heat transfer/stress analyses have been completed and detained component designs are underway.

RADIAL VS. BIAS PLY TIRES

A study of technical reports of projects completed between 1969 to 1979 determined radial ply tires were superior to bias ply tires. The study established that radial ply have increased traction and better lateral stability, increased tread life, improved puncture resistance, and decreased rolling resistance. Efforts began to introduce radial tires into the Army system with low rate initial production of approximately 1000 tires for the 5-ton trucks. These tires are to be issued to select troops to establish ther performance in the field. Service test results will determine whether or not to use new military tread radial ply tires on all new production and development tactical vehicles.

BEADLESS TIRES WITH "RUN-FLAT" CAPABILITY

The tires on wheeled military vehicles are subject to damage from rocks, gunfire, and mine fields. Mission failure may result if vehicles are not equipped with tires that have an inherent ability to operate in a "run-flat" condition. A version of this kind of tire has been developed.

The innovation is based on a new carcass construction, i.e., a beadless tire in the form of a hollow toroid of radial construction. The changes in design result in operating characteristics significantly different from those of a conventional bias ply tire. Among the advantages claimed are their higher load carrying ability at higher speeds; longer tread life; increased resistance to tire damage; improved fatigue life and reduced safety hazard due to blowouts. It is also claimed to have the ability to "run-flat" on a hard surface for at least 30 miles at 30 miles per hour.

Based on an unsolicited proposal, six tires were purchased in FY80. FY81 funds will be used to test the tires to substantiate their "run-flat" capabilities, and performance in a military environment.

BANDED RADIAL PLY TIRES

The Banded Radial Ply Tires Project objective was to develop a radial tire capable of supporting its design load without air pressure by incorporating a solid flexible band of high strength material under the tread as a combat (low-vulnerability) tire. Bands for the prototype tires were fabricated from steel, aluminum and fiberglass/epoxy materials. From preliminary static and dynamic tests conducted in the laboratories, fiberglass was selected as the best suited band material that could be designed to satisfy both the inflated and run-flat cases without sidewall enhancement Vehicle tests were conducted using fiberglass banded tires with a high void ratio diamond pattern tread pattern. Compared to the standard 9.50 R 16.5 original equipment tire, the banded tire had lower rolling resistance, less traction in weak soil, lower noise level than standards established by EPA and a final run-flat test of 88 miles at speeds of 20-40 MPH.

BATTERY SYSTEM IMPROVEMENT PROGRAM

A comprehensive testing and evaluation program of the new low maintenance storage battery, developed in FY79, was completed in the 4th Qtr of FY80. A new battery draft specification for initial procurement was completed, and is being processed for industry and Tri-Service coordination. The new low maintenance combat vehicle 6TN NATO standard size battery will be procured from this new specification. A program for the development of the tactical vehicle battery, the smaller of the two NATO standard sizes, was initiated. The battery will be designed into a new plastic container, and will use the low maintenance battery concept. A contract award is scheduled for early FY81 to provide prototypes of the new low maintenance 2HN size tactical vehicle resistance container will markedly reduce field breakage. The internal design, using the "maintenance-free" concept, will inherently

provide capabilities and characteristics for long term "wet" storage life, reducing failures due to sulfation and virtually eliminating failures in the field fue to overcharging.

12/24 VOLT CONVERTER

A 12/24 volt conversion unit for providing 24 volt power on commercial vehicles procured by the military is being tested.

The proposed converter will supplant the current procedure of adding a complete new 24 volt system to each vehicle, complete with two 12-volt batteries, a 24-volt regulator, and a 24-volt alternator with drive pulley and belts. The converter is to be employed for operating radio sets, gun firing solenoids, rotating warning beacons, and other lights and devices currently powered by 24-volt military vehicle electrical systems. The new system has been installed on five vehicles at Ft. Lewis, Washington, and one vehicle at TARADCOM with successful results to date.

12-VOLT INTER-VEHICLE SLAVE CABLE KIT

The 12-Volt Inter-Vehicle Slave Cable Kit Project objective was to provide 12-volt military tactical vehicles with a convenient, practical, and safe method for starting a disabled vehicle of the same type 12-volt electrical system. The kit consists of an external vehicle receptacle and an inter-vehicle cable with mating connectors. The receptacle and connectors are of a design that precludes the use on 24-volt vehicles. Sample kits have been successfully tested at Yuma Proving Grounds and the Cold Regions Test Center. Input data for incorporation into both the military standard (MS) and the military specification was prepared. The documentation assures that the future procurement of the 12-volt inter-vehicle slave cable kit will be manufactured to the new military standard and specification.

SINGLE LEVER LIGHT SWITCH

The Single Lever Light Switch Project objective is to provide a new easily operated military light switch with a simple design. The present three-lever military switch is difficult to operate. The new single lever switch will provide infinite pilot lamp dimming, a requirement of the National Highway Safety Standard. The new switch is interchangeable with the current three-lever military switch. Fifteen switches have been fabricated and four switches are undergoing laboratory tests. An extensive field-test program on vehicles at Ft. Knox is planned. Project completion is scheduled for 1st Qtr FY81.

ROTATIONAL MOLDED POLYETHYLENE FUEL TANKS

Manufacturing technology revealed rotational molded cross-linkable high density polyethylene plastic exhibited the desirable chemical and physical properties for the fabrication of large capacity fuel tanks for the M551 Vehicle.

A contract is being negotiated for the tooling of a permanent cast aluminum molt for the 5-Ton cargo truck fuel tank. The mold is to be shot peen textured, incorporating the necessary ribs (fillets) and corner radii, to maintain fuel tank shape installed, including fuel weight and sidewall effects. Fuel tanks will then be subjected to durability testing. Results can then be obtained as to the fielding of rotational molded cross-linkable high-density polyethylene fuel tanks.

SELF-FORMING GASKET MATERIAL

The Self-Forming Gasket Material Program was to utilize commercially available self-curing plastic material to form in-place-gaskets (FIPG) as a replacement for preformed cork, paper, and rubber gaskets in military vehicle. A thin bead of paste-consistency, room-temperature vulcanized (RTV) silicone flows between them, filling all voids and irregularities. The gasket cures in presence of moisture to a solid silicone rubber gasket that has excellent flexibility, thermal stability, and fluid resistance.

Field test results, using tactical vehicle components at Tooele Army Depot, Utah, proved that the RTV is recommended for (1) making emergency repairs, (2) as a substitute for any non-shimmering or non-metallic gaskets not used in the exhaust system or in direct contact with liquid fuel, and (3) use in conjunction with gaskets to help seal troublesome areas.

VEHICLE NOISE REDUCTION

During FY80, a noise measurement and reduction test facility, has been completed to enable TACOM vehicles to meet MIL-STD-1474B. A semi-anechoic chamber has been equipped with acoustic instrumentation and a roadwheel dynamometer. The vehicle test room has a steel reinforced concrete floor, intake and exhaust blowers, a roof that can be raised, and a control room. The acoustic wedges in the chamber are 26 in. long and have a 200Hz cut-off frequency below which they are less than 97 percent absorptive. A test vehicle can be subjected to every driving condition from idle to full throttle at speeds up to 70 mph. An accompanying control console displays road speed and road horsepower. A strip-chart recorded can be used as a driving-aid. The procedure for baseline noise testing has been developed.

RISE POWER TRAIN PIP: M113A1E1 VEHICLE DEVELOPMENT

The Rise Power Train PIP includes the turbocharging of the present 6V53 diesel engine and the addition of a hydrokinetic transmission providing an increase in reliability, availability, maintainability (RAM) and vehicle performance. The major drive line changes resulting from the use of the hydrokinetic transmission involve the replacement of the TX100-1 transmission, transfer gear case, steering differential and pivot brakes with the X200-3 transmission. The replacement of these components results in an increase in overall drive line RAM-D (RAM plus durability). In addition to these drive line changes, the current 6V53 engine was turbocharged to increase the rated horsepower from 212 to 275 HP. The turbocharged engine is designated the 6V53T and is essentially the same as the engine in the M551A1. This restores and surpasses the original HP/Ton design ratio for the M113 family.

ADVANCED ANTIARMOR VEHICLE EVALUATION

TARADCOM completed the design, fabrication, shakedown testing, and delivery to the 10 surrogate vehicles (extensively modified M551A1's) to be used for the Advanced Antiarmor Vehicle Evaluation (ARMVAL) Joint Operational Test and Evaluation (JOT&E). The major modifications consisted of: (a) replacing existing engines with Code "A" 8V53T engines, (b) reducing vehicle weight to approximately 26,000 lb, (c) replacing existing torsion bars with newly designed bars, (d) providing the commander with a single M20A3 periscope and lightweight cupola, (e) modifying the turret to accept an M36E2 gunner's sight that will be stabilized in vertical and horizontal axes, (f) providing an additional independent STAGET sight system stabilized in vertical and horizontal modes with TV monitored viewing for both commander and gunner, and (g) integrating eye safety lasers into both the M36E2 and STAGET sighting systems.

The first completed surrogate vehicle was to be delivered to the Combat Development Experimentation Center (CDEC) for pilot instrumentation in Feb 80. Surrogate vehicles no. 2-4 arrived at Camp Pendleton, CA in Apr 80 for six weeks of Surrogate Crew and Friendly/Threat Force Training. Vehicles no. 5-10 were delivered on schedule to Ft. Hunter-Liggett, Jolon, CA in Jun 80.

During the late third and early fourth quarters FY80, logistic support planning and provisioning efforts were being accomplished on site, Ft. Hunter-Liggett, to accommodate the forthcoming 16 week field test. The objectives of the JOT&E are to obtain data in four major areas that will assist in determining whether combined arms forces can effectively use lightweight highly mobile and agile combat vehicles. these four areas are Combat Effectiveness, Identifying Potential Command and Control Problems, Evaluating Tactics and Techniques, and Identifying Potential Logistical Supportability Problems.

The data generated will be a factor in USMC and Army decisions concerning future lightweight

SMALL UNIT SUPPORT VEHICLE

For over 10 years the Alaskan Infantry Brigade has had a requirement for a small, lightweight vehicle with a high degree of mobility over snow and soft soil. The Swedish Defense Forces signed a contract in Jun 79 to procure the BV206, with a 136 HP gasoline engine, is available for export. TACOM is conducting meetinge with USER and logistics representatives to develop and finalize the plans for competitive nondevelopment item (NDI) acquisition program. One candidate is the BV206.

BV206 in Action

combat vehicle development.

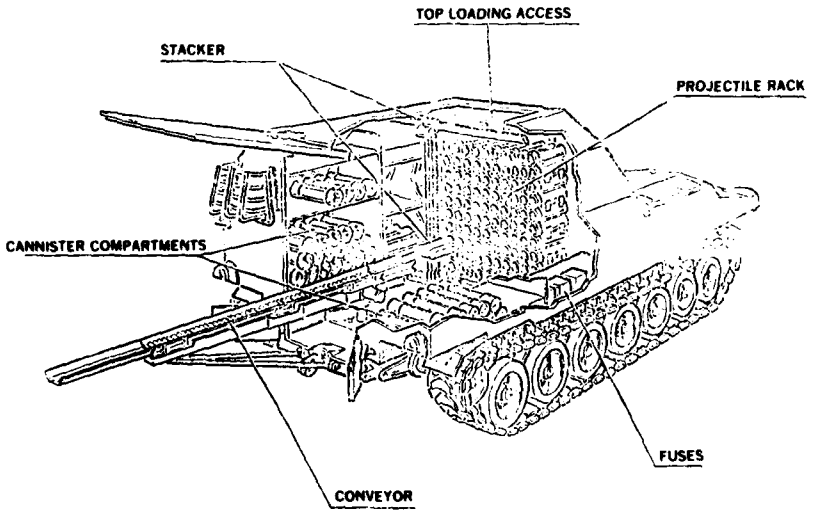
The two sided Force-on-Force field experiment commenced on 8 Sep 80 as scheduled. The surrogate vehicles performed well during the first weeks of field testing and acquired a reputation for being ready for field service. The field trials are scheduled for completion of 15 Dec 80. A data reduction and analysis period will follow with joint tech data (JTD) report anticipated in the third quarter FY81.

FIELD ARTILLERY AMMUNITION SUPPORT VEHICLE

The Field Artillery Board conducted an evaluation of a Field Artillery Ammunition Support Vehicle (FAASV) test rig during Nov-Dec 79 and concluded that the FAASV was a sound concept.

TARADCOM participated in a mini-COEA and a series of decision briefings that resulted in Department of Army approval of the FAASV program on 19 Mar 80 as a non-major system. The DA decision separated the FAASV development program from the Armored Combat Logistic Support Vehicle (ACLSV) family and designated the M109 chassis for the FAASV.

Funds for the FAASV program were received 28 Jul 80. The FY80 planning and management efforts will result in early design, fabricaiton, evaluation and type classification of the FAASV system. A Request for Proposal (RFP) has been released for competitive procurement for design, fabrication, test support, and to provide Integrated Logistic Support (ILS) for the FAASV system. Contract award is expected to be made early in CY81 for the design and fabrication of five prototype vehicles.



M551 MID-LIFE PRODUCT IMPROVEMENT PROGRAM

Field application of the active Army Vehicle Fleet (140 M551 vehicles) began in May 1980 at Fort Bragg, NC and the National Guard and war reserves at Annison Army Depot, AL. This program is currently three months ahead of schedule. The program at Anniston Army Depot has been accelerated to complete 75 vehicles in fourth quarter 80. The overall M551 Reliability, Availability, and Maintainability-Durability (RAM-D) PIP Program was transitioned from TARADCOM to TACOM on 1 Aug 80.

REMOTE CONTROL TARGET VEHICLES

Line-of-Sight Radio Control System. Conventional line-of-sight (LOS) radio-controlled Remote Control Target Vehicles (RCTVs) were provided to support the Operational Test and Evaluation Agency's (OTEA's) examinations. Twelve M114 Remote Control Target Vehicles (RCTVs) were used at Ft. Bliss during the third and fourth quarter FY80 in the DIVAD Gun OT II. During the third quarter, twelve M47 RCTVs were used as back-up targets at Ft. Hunter-Liggett for the HELLFIRE Operational Test (OT) II. Six M47 RCTVs were used as back-up targets at Ft. Carson during Infantry Fighting Vehicle (IFV) OT II in the first quarter FY80. The current LOS RCTV hardware was designated, fabricated and operated as in-house TARADCOM efforts. This equipment utilizes an obsolete military radio transmitter (the ARW 80) for which spare parts are very difficult to obtain. During FY81, a new LOS system utilizing modern state-of-the-art components common to the radio frequency grid system shall be developed and demonstrated.

Radio Frequency Grid System. The radio frequency (RF) grid telecommand system automatically

controls multiple threat vehicles over uneven terrain for both testing and training. The system is based on three transportable radio transmitters which generate a local hyperbolic grid, and the vehicle mounted receiver microcomputer and servomechanisms which guide the target vehicle by remotely retracing any arbitrary course which has been programmed simply by driving the vehicle. Advantages include non-line-of-sight, day and night, and multiple vehicle operations using terrain cover when available.

Twelve advanced development prototype M47 tank RCTVs were completed and underwent the baptism of live fire during the HELLFIRE OT II in the third quarter FY80.

MANNED EVASIVE TARGET TANK

Three Manned Evasive Target Tanks (METT) have been fabricated by TARADCOM for the Operational Test and Evaluation Agency (OTEA) to provide realistic combat vehicle targets for anti-armor missile testing. During FY80 several modifications were installed into the METT vehicles to prevent entry of small airborne metal and dust particles. The particles entered the crew compartment through the ventilation system and around periscopes during tests where inert TOW missles were fired against it. Planned activities for FY81 call for testing to qualify the METT against subcaliber inert VIPER missiles at very close ranges.

FMS TECHNICAL SUPPORT ACTIVITIES

TARADCOM provided automotive support to two teams which conducted surveys in Egypt to determine what technical assistance could be provided to keep certain combat vehicles operational in future years.

FIRE CONTROL SYSTEMS INTEGRATION

TARADCOM's fire control systems objective is to coordinate and integrate fire control developments by various DARCOM Commands and organizations to assure that new technologies progress toward fielding in an orderly manner, time-phased with related combat vehicle systems. TARADCOM funded selected technologies and system developments in FY80 infulfillment of their objective to coordinate and integrate fire control developments. During FY80, TARADCOM continued to provide support to the Human Engineering Laboratory for development of the Fire Control Research System test bed which will provide for data collection associated with the man/machine interfaces of tank fire control systems.

The initial effort of the study entitled "Fire Control Concepts for Maneuvering Targets" was completed during FY80. The first phase of this analytical effort produced fire control system models and analytical techniques for evaluating the performance of tank fire control systems. During FY81, a maneuvering target model developed by AMSAA will be validated using field test data and an appropriate analytical model of the human gunner will be developed. The developed models will be used to compare both analytically and by simulation selected fire control configurations in order to furnish specific guidance for future fire control system development.

The maneuvering target test of the GM version XM1 fire control system was not able to be conducted as originally planned. TARADCOM assisted ARRADCOM during FY80 in updating the Army Fire Control Science and Technology Base Planning Guide. FY81 activities will continue to inject detailed combat vheicle oriented fire control programs, highlighted in the fire control planning guide, into the combat vehicle science and technology base.

ARMY FIRE CONTROL PLANNING GUIDE SUPPORT

TARADCOM assisted ARRADCOM during FY80 in updating the Army Fire Control Science and Technology Base Planning Guide. FY81 activities will continue to inject detailed combat vehicle oriented fire control programs, highlighted in the fire control planning guide.

TURRET AND WEAPON SYSTEM INTEGRATION

The turret and weapon station integration involves several tasks which will result in advanced systems and techniques for TARADCOM to utilize in its role as systems integrator of total combat vehicles. The objective of this task is the coordination of development efforts leading to the integration of technology within the turret under the constraints of technology, cost, weight, space, human factors, complexity, and performance. During FY80, several activities were undertaked concurrently.

Position Control System. The Position Control System activity was initiated to evaluate position vs. rate inputs to the turret/weapon drive system and the potential enhancement of target tracking capabilities against evasive targets. A displacement sensitive trackball control system was built and testing and evaluation were initiated. During FY80, testing included evaluation on the Human Engineering Laboratory (HEL) tracking simulator and in a vehicle installation in the ARRADCOM M60 test bed. Tests indicate a potential improvement in operator performance and the need for further testing. Activities were extended to include a coordinated TARADCOM-HEL PCS evaluation of the TARADCOM dynamic ride simulator.

Fluidic Tank Turret Stabilization. The fluidic stabilization study objectives in FY80 were to assess performance trade offs between various

hybrid turret stabilization systems in terms of the XM-1 performance requirements. The study concluded that development of a pneumatic gyro replacement rate sensor for application in a hybrid pneumatic/electronic system would be the most readily implemented improvement for the XM-1 system.

As a result of the fluidic stabilization feasibility study, development of a pneumatic gyro rate sensor, to replace the current XM-1 gyro, has been undertaken and will be completed during FY83. The hybrid pneumatic/electronic system is expected to provide vital data to prove the concept of a direct gyro replacement and to document the improvement in maintaining accuracy on target while the vehicle is on the move.

A concept study for specific applications of an all pneumatic stabilization system for the XM-1 has been initiated with a scheduled completion date of Feb 81. In conjunction with the analytical comparison between the hybrid and the XM-1 systems, this study will provide a data base for more efectively interfacing gun, turret, and sight stabilization components.

AUTOMATIC TRACKER EVALUATION

During FY80, TARADCOM provided $350K of AH91 funds in support of the ARRADCOM automatic target tracking technology program for combat vehicles. The support effort has been directed toward the procurement of a competitive auto-tracker for evaluation. During FY81, integration and testing of the competitive hardware on the ARRADCOM M60 D^2T test bed will be accomplished.

GUN TUBE BENDING ANALYSIS

FY80 Gun Tube Bending Analysis included publication of a final report highlighting appreciable errors induced by gun tube bending as a function of mobility and vehicle transmitter terrain inputs. Reduced FY80 funding prohibits the extension of similar simulation activities.

FIRE SURVIVABILITY SYSTEM INTEGRATION

The Fire Survivability System Integration Program objectives are to coordinate all DARCOM programs related to fire survivability and to initiate new technologies that enhance vehicel fire survivability. The Mobility Equipment Research and Development Command (MERADCOM) has modified two fire extinguisher recharge sets to be tested to support the XM1 Operational Test (OT) III. The TACOM Propulsion Systems Division is conducting a 400 hour test on Aircooled "V" Diesel Supercharged (AVDS) 1790 engine with MERADCOM's Fire Resistant Fuel. New fire detection and suppression programs were initiated including investigations of improved extinguishers and more effective optical detection systems. The projects initiated in FY80 will be continued into FY81. Support will be given to M60 and USMC LVTP7A1 programs to implement automatic fire detection and suppression product improvement programs.

PASSIVE FIRE PROTECTION FOR HYDRAULIC AND FUEL LINES

The Passive Fire Protection for Hydraulic and Fuel Lines Program objective is to prove the feasibility of a passive fire suppression system for hydraulic and fuel lines. Unprotected lines are vulnerable to rupture and ignition resulting in an explosive fire. Lines are hazardous when located outside the view of optical fire sensors. This system will provide fire suppressant jacketing which, when ruptured, will supply a suppressant cloud (probably a dry powder chemical agent suspended in a thixogelled HALON) precisely at a point of the rupture. During FY80 a contract was awarded for the design and fabrication of experimental hardware. During FY81, a realistic test procedure and base line threat data will be developed with actual evaluation of the passive suppression system scheduled for mid-FY82.

GAS-LIQUID DYNAMICS

The Gas-Liquid Dynamics Program objective is to determine the rate at which multi-phase flow occurs in the HALON-1301 combat vehicle fire extinguishers in fixed systems, whether by free flow or through a distribution system. The program determines the limiting rate of phase change of a condensible gas (Halon-1301) when it is suddenly allowed to go to vapor-gas-liquid. The problem becomes further complicated when the liquid Halon-1301 is superpressurized and saturated with approximatley half the weight of the nitrogen in solution within the liquid Halon-1301 at standard conditions. In FY80 Phase I involving a computer model for the free flow blowdown system was completed. In FY81, under the Fire Survivability System Integration Program, Phase II will entail a computer model for distribution systems and verification testing for both models to generate empirical constants for the models. In FY82, a design manual will be published from the test results.

HUMAN FACTORS EVALUATION-ARMORED COMBAT VEHICLE TECHNOLOGY

Fire-on-the-move studies to assess gunner performance using alternative gunner station designs have been completed ahead of schedule. The studies by TARADCOM, the Armor Engineering Board, and the Human Engineering Laboratory were conducted using TARADCOM's ride simulator, hybrid computer and a modified target visual display simulator. Gunners from Fort Knox, KY were seated in a mock-up of the M60 tank gunner's station fitted to the ride simulator and were required to acquire track and "engage" simulated stationary and maneuvering targets generated by the target display simulator. The gunners were subjected to vertical, pitch and roll motions, which duplicated the motions encountered at the tank gunner's station. The terrain profiles, which were delivered to the seat by the hybrid computer, ranged from stationary to severe cross-country rides. The hybrid computer also supplied recoil motions to the seat at each trigger pull. The test set up, designes by TARADCOM, was used to conduct 2400 target runs and automatically collected tracking error data at 100 samples per second and firing error data at each of the over 22,800 trigger pulls. The six channels of data were stored on magnetic tape.

Test conclusions note that simulations are effective in determining optimum gunner station design. Testing of alternative components, such as monocular versus video display sights and yoke versus isometric control handle combinations, have yielded valuable information for assessing which gunner station configuration will provide the best fire-on-the-move capabilities. Follow-on testing using several new gunner station components, such as different gunner seats and refinements to existing configurations based on data gathered from this test, will be conducted in early FY81 to optimize the gunner station configuration.

XT152 45-65 TON VEHICLE TRACK

The XT152 45-65 Vehicle Track program was initiated to address shortcomings in maintenance, life, and operating characteristics for the heavy (45-65 Ton) weight class combat vehicles, and is aimed at designing a highly functional and economical track which will be interoperable on the XM1, M48, and M60 tanks and the M88 recovery vehicle. Improvements of 50 percent minimum increase in pad life and basic track life equal to vehicle rebuild cycle are expected using new track concept which includes quick-disconnect pads and optimized groung/track interface dynamics. A new shoe/pad configuration incorporates a twist-loc mechanism and chevron shaped pad which have demonstrated ease of replacement and reduced pad cutting and chunking. The shoe body is designed to be cast of forged, in order to enlarge the production base. A new centerguide configuration has been developed to improve wheel/guide/pin interfaces and reduce track misguiding and guide failures. Track pin, bushing, and end connector modifications also have been made to improve basic track life and reduce maintenance requirements. Initial FY79 development effort culminated in a 3500 mile evaluation of 50 28 in. prototype track shoes at Yuma Proving Grounds, demonstrating a 50 percent minimum pad life increase potential over T142 track. During FY80, the XT152 track was designed and sex vehicle sets of track are currently being fabricated for full scale vehicle evaluations at Yuma Proving Grounds, Aberdeen Proving Grounds, and Ft. Knox on M60 and XM1 vehicles during FY81.

TRACK FOR 15 - 18 TON VEHICLES (XT-150)

New track and sprocket designed for vehicles in the 15-18 ton weight category are being tested at Nevada Auto Test Center. Tests are nearly completed. A second generation track has been fabricated and tests are beginning at Aberdeen Proving Grounds, Yuma Proving Grounds, and Ft. Lewis. The track is a double pin, extended end connector design with quick disconnect/replaceable chevron pads.

TRACK BUSHING TEST MACHINE

A series of bushing tests have been conducted with a new bushing test machine. Test results have demonstrated repeatability and validity. Development of the test machine has been completed.

ROAD WHEEL TIRE BONDING

Field and laboratory testing of precured solid rubber tires indicates that the bonding technique developed is successful. Equipment to perform the bonding process between tire and wheel disc, using an adhesive and pressure applying device, has been delivered.

TRACK RETENTION AND CONTROL

Resilient Sprocket Teeth. The Resilient Sprocket Teeth program will develop a drive sprocket with resilient teeth. Individual teeth will be mounted on a sprocket body and partially supported by rubber to permit slight yielding as tangential loads are applied. The objective is improved track engagement; reduced loading, noise, and vibration; and improved track and sprocket life.

Progress in FY80 included the design of the system and a detailed drawing. The plans for FY81 include procurement of hardware for installation on an M113 vehicle and commence testing.

Tensioning Adjustment System. The Tensioning Adjustment System program will develop a system to monitor and adjust track tension while the vehicle is underway. The objective is to maintain optimum tension to minimize track loss and assure satisfactory vehicle performance. The concept was formulated in FY80. Plans for FY81 include drawings of the system, procurement of hardware, and installation on an M113 test vehicle.

MILITARY ELASTOMERS

In order to improve the life of the track rubber, and thus lengthen the serviceability time of tracked vehicles, several projects to improve track elastomer life cycles have been undertaken.

Fundamental Studies in Military Elastomers. The program was initiated to ascertain causes of modes of failures in track pads. A finite element analysis has been developed of the T142 pads. Roundary conditions are being determined and the results, together with field and vehicle test results, inserted into the finite element analysis model. This will facilitate property structure relationship studies.

Track Inserts and Fillers. Track pads containing Kevlar were tested at Yuma Proving Ground for 2000 miles on pavement, 1000 miles over secondary gravel roads and 500 miles cross-country. The pads from the three qualified vendors were all able to negotiate 2000 miles on pavements and 1000 miles on secondary gravel roads. They all failed on 366 miles cross-country. The Kevlar containing pads from one contractor appeared to show improvement over his base material. The Kevlar material from the other contractor showed a decrease in effectiveness. Phase II of this program has been initiated using XT-152 pads. Samples obtained during test operations have been submitted to both Virginia Polytechnic Institute and to Lawrence Livermore Laboratory for examinations. Indications are that, as suspected, changes are taking place in the material during vehicle operation. A program has been submitted to treat the fiber surfaces to make them more acceptable to the elastomeric milieu.

Guayule-Lignin Rubber for Track Roadwheels and Bushings. Guayule rubber is a natural rubber obtained from a plant which can be used to replace the Hevea rubber obtained from a tree. Advantages of Guayule rubber as opposed to Hevea rubber are:

a. It can be grown in the United States and thus reduces dependence upon foreign imports.

b. It is a natural rubber and does not require petro-chemicals in its production as does synthetic rubber.

Problems have been encountered obtaining guayule. Because of the limited samples the smaller T-130 pads were made are are awaiting vehicle availability for field testing. Programs have been initiated to study compounding, testing, and formulation.

BI-DIRECTIONAL SUSPENSION SYSTEM

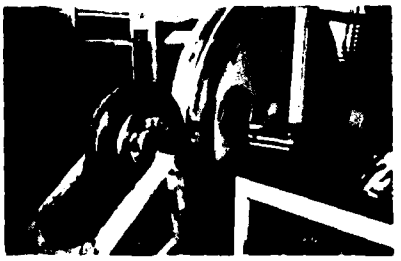
Development of a FORTRAN ride dynamics analysis technique in FY80 showed evidence of an improvement of an articulated roadarm under the standard M60 suspension in terms of driver-absorbed power and root mean square (RMS) driver acceleration. This conclusion was based upon an analysis using single rough terrain course and did not reflect extensive variation or attempts at optimization. During this preliminary study, three concepts were investigated on a theoretical basis, each of which showed some potential ride improvement. Comparative analysis of the ride dynamics indicated that the longitudinal absorbed power varied significantly. In FY81, the first task will be the development of a simple linear single degree of freedom mathematical model that can be solved in closed form for single input. Analysis of this simple model will provide graphs that define the basic relationship and mechanism for longitudinal force input to the vehicle hull. It wil also provide a basis for the systematic analysis of the more complex non-linear computer models used in subsequent tasks. With results of longitudinal compliance evaluation, a fixed representative value of compliance will be chosen and a computer search for damping optimization will be undertaken. Once the analytical investigation is complete, concept sketches will be developed depicting different hardware implementations in an actual vehicle suspension. A trade matrix of performance, cost, retrofit potential, complexity, reliability, availability and maintainability plus durability (RAM-D), will be developed for evaluating each concept. The candidate selected will be used in the FORTRAN ride simulation model for final performance evaluation of the concept compared to standard parent vehicle.

ADAPTIVE SUSPENSION

In FY80, a hybrid computer suspension optimization program was initiated to identify the springing and damping characteristics necessary for optimum vehicle performance in representative terrain ranges. A terrain sensor/micro-processor/logic system development also was initiated. A road arm mounted accelerometer was selected as terrain profile sensing element and the preliminary processing technique and microprocessor configuration were identified. Reconditioning the T95 piston hydro vehicle for use as a test rig to evaluate manual variations of suspension characteristics was initiated.

VEHICLE HARDENING (TRACK AND SUSPENSION)

The vehicle hardening program was initiated to reduce the vulnerability of Army tracked combat vehicles to land mine attack without degrading the vehicles' required operational capabilities. The objectives of the hardened suspension system are to provide future armored vehicles with the capability to: (1) encounter an air scatterable explosive charge detonation and continue on its intended mission and (2) encounter a large anti-tank mine and have sufficient mobility to withdraw from the range of anti-tank weapons or otherwise limp to a repair location. In addition, the hardened system offers potential advantages in reducing the need for mine detection and other overt mine neutralization schemes. It attenuates the peak blast impact impulses to the interior mounted equipment and the crew. The approach is to redesign configurations capable of absorbing or reflecting the mine blast. The system concept consists of a single roadwheel at each wheel station in lieu of dual wheels to minimize the wheel profile presented to the blast. The composite roadwheel is contoured to run in and be guided by a groove in the track. The track is redesigned so that the track envelope remains intact after the blast to maintain vehicle mobility. The basic track framework is covered by a composite material that is sacrificed during the blast to protect the track and roadwheels. In FY80, a 400 mile mobility test run was initiated to demonstrate the before-blast vehicle performance. An M60A1 Tank, equipped with the hardened system on one side and the conventional system on the other, was used to evaluate six track composite and three roadwheel composite materials. Design of test equipement, conduct of laboratory tests and evaluation of results continued to establish the conventional test baseline and hardened concept comparison.



Composite roadwheel specimen being checked for critical surface temperature by Thermocouple Indicator after durability test run on NBS drum test machine.

INDEPENDENT EXTERNAL SUSPENSION

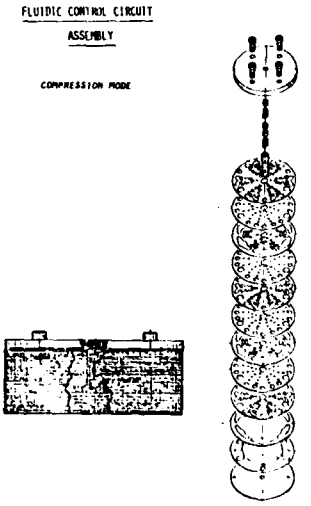
The Independent External Suspension program was initiated to design and develop a high-mobility tracked vehicle springing and damping system exterior to the hull. The complete springing and damping mechanism is contained within the roadwheel arm. Using this approach, the overall suspension weight is expected to be reduced because the roadwheel arm housing will perform two functions: (1) roadwheel load support and (2) housing for springs and damping components. Future plans include continued operation of the 20-25 ton test vehicle to accumulate a goal of 6,000 miles over highway, secondary roads, and a variety of cross-country terrains to obtain durability indications on the suspension system. Design refinements will be made as necessary to complete the exploratory development late in FY81 or early FY82. Design effort (advanced development) on the 60-65+ ton system will continue through FY81 and be completed in FY82. Procurement of test hardware for one XM-1 weight class vehicle will immediately follow.

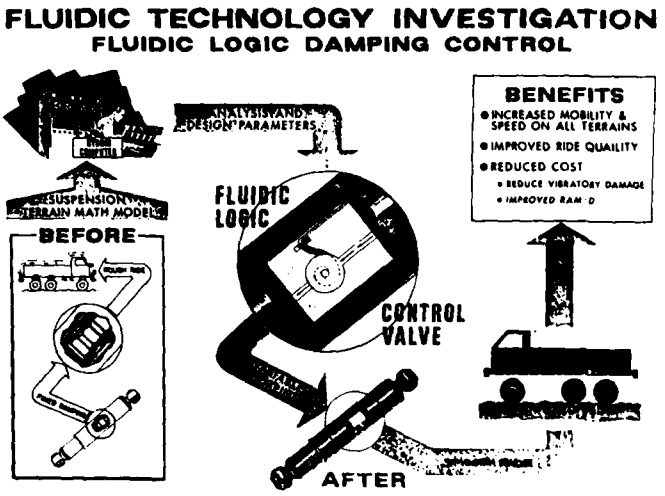
FLUIDIC DAMPER

The Fluid Damper Program was established to develop a fluidically controlled, adaptive damper suitable for the M113 class vehicles that would increase MMBF and reduce shock loads to the vehicle in rough terrain, thereby increasing mobility, ride quality, gun platform stability, RAM-D and reduce costs.

During FY80, breadboard units were completed and in-house data acquisition was used to generate force-velocity-acceleration graphs of damper performance. A force turndown of 4.5 to 1 was demonstrated between 16 and 206 imput to the test unit.

FY81 plans include fabrication and testing of self-contained dampers with improved accelerometers, developemnt of laminate stack bonding technique, fabrication of field test units and on-vehicle test and evaluation of the fluidic adaptive damper concept.





LOOPWHEEL SUSPENSION

Loopwheel Suspension Program was established to further develop and evaluate the feasibility of the loopwheel concept for military automotive vehicles. Through this concept, the elimination of components such as roadwheel arms and roadwheels has the potential for providing a lighter weight, simpler suspension system. During FY80, design and fabrication of component parts for the loopwheel suspension system were completed. Two generations of loops were tested on the 3000 pound loopwheel demonstration vehicle. Vehicle ride and engineering tests were completed. FY81 plans include the design, testing and vehicle evaluation of the third generation improved life loops.

LASER HEAT TREATING OF TRACK COMPONENTS

The first laser heat treating operations of track components have demonstrated positive results. A continuing contract will expand the scope of available specimens which will be heat treated and installed on test vehicles.

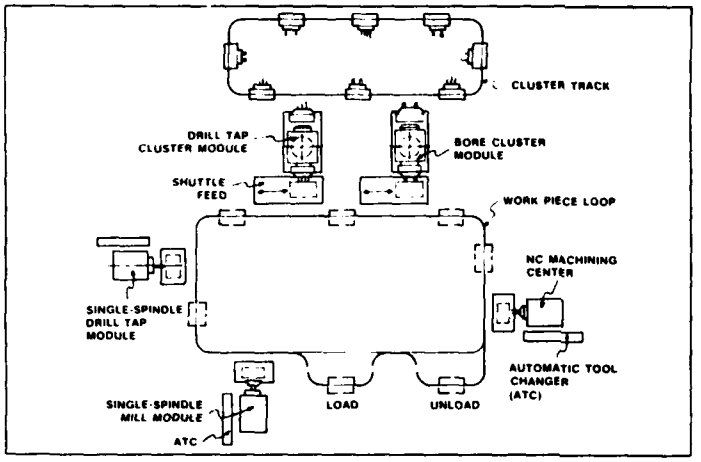
DISSIMILAR METALS JOINING

The joining of dissimilar metals program is meant to develop, without bolting or riveting, optimum production welding techniques and weld joint geometries for the application of dissimilar metals to combat vehicles. The technique will assure incorporation of dissimilar metals in a vehicle to provide the required ballistic and structural integrity. Here, aluminum and steel are used. The program is expected to improve ballistic capability and reduce weight to increase combat vehicle mobility and reliability. The protection capability of aluminum armored vehicles could be enhanced by the use of steel in specific areas.

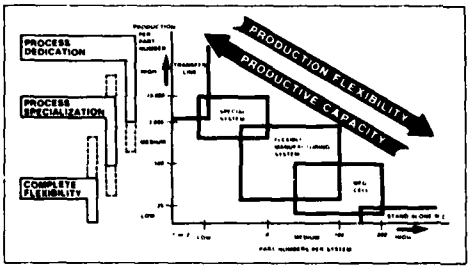
FLEXIBLE MACHINING SYSTEMS VEHICLE COMPONENTS

Flexible Machining Systems (FMS) Vehicle Components Program was initiated to support and advance the use of the flexible machining system concept by producers of tank-automotive components. The flexible machining system approach is one of the most viable of the computer aided manufacturing (CAM) concepts for handling intermediate quantities (1000 to 100,000) of machined parts normally handled in batch operations.

The flexible machining system concept provides a system for maintaining the high level of flexibility associated with stand-alone numerical control and gaining the high productive capacity associated with transfer-line production. It is achieved by grouping a medium number of parts having similar work content and size into a family which can be economically handled in an automated manner. The system contains specialized work modules and fully automated working and material handling systems, all under computer control.



FMS Configuration Scheme for Tank Parts



Manufacturing Concepts, Productivity vs Flexibility

THREADED FASTENERS - LOCKING ADHESIVES AND SEALANTS

Commercially available anaerobic adhesives for thread locking applications are being evaluated through laboratory and field testing to determine the applicability to Army requirements. Use of these thread locking adhesives provides a simple and economical method of applying locking torque to all threaded fasteners. These adhesives also prevent corrosion, eliminating the problem of removing old fasteners. Field testing currently is being performen on 10 modified M551 vehicles. The air screw bracket and power plant assembly utilized anaerobic adhesives. A M151 vehicle is being tested with anaerobic adhesives on the door hinge bolts. Self curing gasket materials are also being evaluated to replace prefabricated gaskets. These tests have been started only recently. This project has application for all present and future military vehicles.

TORSION BAR DEVELOPMENT

Evaluation of high-strength steel torsion bars in support of ARMVAL and the M548A1 suspension system PIP program were completed by the Torsion Bar Development Center in FY80. Presently underway is a test program initiated during FY80 for evaluation of a torsion bar for the M113A2 which, if developed and proven successful, could result in a potential 50 percent procurement cost savings over the current M113A2 high-strength steel torsion bar.

LASER WELDING TECHNIQUES FOR MILITARY VEHICLES

The Illinois Institute of Technology has coordinated with XM-1 personnel at the Lima Tank Plant to identify joint welds which could be welded by the Laser welding process. H-plates will be fabricated using this process and ballistically tested. If successful, the results of laser welding are expected to reduce labor costs and increase production speed. Another advantage will be a reduced health hazard from noxious fumes.

GEAR DIE DESIGN AND MANUFACTURING

Gear Die Design and Manufacturing, computer programs for the generation of the gear geometry and analysis of gear tooth deflections have been debugged, and the finite element programs for the calculation of stresses, temperatures, and die deflections are almost complete. The effectiveness of this computer aided design and manufacturing process will be demonstrated by producing prototype differntial gears for a medium weight truck and transmission gears for the XM-1 AGT-1500 engine.

ELECTRODES FOR WELDING STEEL ARMOR

Several electrodes for welding steel armor were selected based on performance in all tests. Ballistic plates are being fabricated and acceptance will be based on weld integrity when ballistically fired during Phase III, scheduled for FY81. In FY79, Phase II testing of candidate electrodes was carried out to determine Charpy V-notch values at minus 60°F, tensile strength, yield strength, elongation, and to make bend and cruciform tests.

CAST ARMOR REPAIR

Large armor castings to MIL-A-11356E are accepted based only on calculations. Actual ballistic firings have not been performed to verify or supplement the calculations. The Cast Armor Repair program consists of preparing simulated repairs of the following casting thicknesses, heat treatments and defect sizes: 4 × 60 × 60, Class B, Size 1, 2 and 3; 4 × 36 × 60, Class C, Size 1; 1½ × 60 × 60, Class B, Size 1, 2 and 3; and 1½ × 36 × 36, Class C, Size 1. Upon completion, the cast plates will be shipped to Aberdeen Proving Grounds for ballistic firing. The results will be evaluated and necessary modifications made to conform to MIL-A-11356E.

IMPROVED LARGE ARMOR STEEL CASTINGS

Research has proven that ballistic performance of cast steel armor can be improved to equal rolled steel armor by the use of controlled solidification methodology. This project was initiated to demonstrate production feasibility and to establish methods and procedures for general use in the manufacture of an improves cast armor. Two contracts were initiated to provide a total of 20 castings each representing both cast plate and the simulation of a cast turret section. Both contractors have submitted flat plates 5 inches thick for ballistic evaluation. Results have shown that production cast plates can be fabricated and heat treated to provide a material apability that exceeds the minimum ballistic equirements of the rolled armor specification (MIL-A-12560).

FABRICATION OF FLAT THIN-GAGE ALLOY STEEL PLATE

The Thin-Gage Alloy Steel Plate project was established to improve manufacturing procedures to produce closer flatness tolerances. The contractor established procedures using platten die quenching followed by roller leveling that produced improved plate flatness. In addition, manufactured plates were subjected to periodic flatness measurements to establish the effects of storage for periods up to 90 days.

LIGHTWEIGHT ARMOR METALS FOR HIGH EXPLOSIVE FRAGMENTATION PROTECTION

The Lightweight Armor Materials for High Explosive Fragmentation Protection Program was concluded in FY80. This effort has expanded the established TARADCOM high explosive (HE) shell fragment armor design computer code to include mortar rounds (81mm and 60mm) and lightweight armor materials, i.e., doron, and bonded and unbonded nylon and kevlar. Previous data base was limited to two HE fragment projectile threats (105mm and 155mm) and two armor materials (rolled steel and aluminum).

SUPPLEMENTAL ARMOR ENGINEERING SUPPORT - XM1

Technical support for the XM1 Project Manager in the development, direction, and analysis of ballistic test programs included test and evaluation of an improved steel air intake grille design and the development of a test method for acceptance evaluation of thin gauge alloy steel plate. Support effort through informal discussions and written comment was provided on armor material and design application questions.

ARMOR PROTECTION FROM OVERHEAD THREATS

A matrix of possible lightweight supplemental armor composites (a maximum allowable weight increase of 70 lb/sq ft) to provide vehicle overhead protection was developed for cost and evaluation at Aberdeen Proving Grounds against both small shaped charges and self-forging fragments. To date, 50 percent of the target configurations have been tested.

COMPOSITE ARMOR

Another system of composite armor material design was defined for test and evaluation in FY80. The design is a spaced applique concept incorporating steel armor plate, ceramic insert elements, and aluminum armor plate. This material system should afford a lightweight armor design for protection against intermediate to high velocity kinetic energy weapons through 30mm in diameter. The Composite Armor Project entails a phased evaluation of ballistic protection capabilities of various material systems which can reduce armor weight and/or simplify

arrangements of high hardness steel on aluminum armor (7039 alloy) ranging in weight from 12 lb/ft² to 55 lb/ft² . Test effort was initiated at the Materiel Test Directorate, Aberdeen Proving Grounds in Jan 79 involving ballistic tests against 7.62mm and 14.5mm AP projectiles. The test was completed in Jul 80. The test information will provide the needed reference data base for proper use of this type of composite armor system for vehicle design.

SPALL PROTECTION

The Spall Protection effort was intended to expand TARADCOM's computer design capability to include considerations of spall liners in an armored vehicle. Using an existing armor design computer program, different analytical procedures have been considered to account for the effects of various spall liners. It was determined that only spallation caused by shaped charged (HEAT) projectiles can be significantly reduced by liners. It also was found that only soft target areas will benefit from the use of spall liners. Therefore, the analytical consideration of spall liner effectiveness is limited to computations involving crew compartment areas when threatened by shaped charged projectiles. Work has been concentrated on devising a different analytical approach for this situation. Adjustments to probablility of kill curves and/or material thickness could provide a practical solution.

DESIGN METHODS FOR BALLISTIC SHOCK

A contract was negotiated for the development of predictive design procedures and protection methods for shielding tank critical components can be damaged by a ballistic impact or high explosive blast even though the vehicle survives the attack. Examples of components that must be shock mounted are the fire control equipment, optics, and electronic gear such as computers and radios. The work effort should provide a more quantitative approach for evaluating shock damage potential and needed protective measures to assure component survivability in the typical combat shock environment, i.e., large caliber non-penetrating armor piercing projectile impacts, and high explosive (HE) blast (mines, shaped charges, and HE shells).

NATO ARMOR PROTECTION/ VULNERABILITY MODEL STANDARDIZATION

This effort is in support of the NATO Armor Protection/Vulnerability Model Standardization Program to obtain a standard armor protection/vulnerability model. TARADCOM representatives participated in special meetings with technical representatives of NATO Working Group 2, AC/225 Panel II, to define and agree on common reference target to permit comparison of various national vulnerability models. The T-62A vehicle was designated for analysis. Vulnerability analysis was performed with the TACOME3 computer model. Results were compiled and documented. Target emphasis then was viewed more desireable in view of work interests of the majority of working group participants. Because of classification considerations, release of common reference drawings could not be made by Ballistic Research Laboratory (BRL) to all group members. Analysis was started by TARADCOM to permit preliminary comparison with similar effort by BRL. This early initiative will generate results for working group meetings tentatively scheduled for Nov 80.

MOLDED PLASTIC ORDNANCE ELECTRICAL CONNECTOR

The Molded Plastic Ordnance Electrical Connector (MPOEC) Project purpose is to develop an optional material to replace the current steel and aluminum ordnance electrical connectors with plastic molded connectors to eliminate corrosion problems and reduce weight and cost. Connectors were fabricated from thermoplastic polyester "Valox 420" and successfully completed validation and laboratory testing and are interchangeable, intermateable, and intermountable with existing metal connectors. Field tests were conducted on 15 vehicles and the plastic connecters were intermounted with steel receptables. The field tests were conducted at -65°F (-54°C) on M151 jeeps and on M113 personnel carriers in Alaska. Tests at Yuma Proving Grounds were on the M113, M60, M818 and M54 vehicles. The results show that after two years there have been no failures or deterioration of MPOEC's and they are a satisfactory replacement for the standard metal connector. All MPOEC's remain installed on those vehicles in their present mixed locations and are subject to periodic observation.

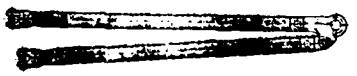
HIGH-STRENGTH MATERIALS AND COMPONENTS

High-strength materials can offer improved component reliability and decreased vehicle life-cycle costs. Lightweight, high-strength materials can offer increased vehicle performance and fuel efficiency, which is important during the energy crisis. The objective of this program is to develop criteria for designing and fabricating large components for high-strength materials. Part of this program effort was concentrated on the M60/XM-1 tow bar. The tow bar currently authorized for issue is heavy and cumbersome (340 lbs., 8½ ft. long). For greater self-recovery capability, a lightweight tow bar with the same performance characteristics is required. Composites, which offer a high directional strength-to-weight ratio, increased stiffness, and low machining costs for this application. An evaluation of the various composite properties, their

resistances to surface degradation, and metal-composite properties, their resistances to surface degradation, and metal-composite bond strength are some of the factors that were considered. The finalized design consisted of steel end fittings and graphite/epoxy tubes with a kevlar overwrap. The overall weight of the bar is only 126 lbs, which represents a 62% weight reduction over the existing design. To date, fabrication of two prototype bars is 90 percent complete. Evaluation has been scheduled during mid-FY81 at TRADOC.

An additional effort, unrelated to the tow bar, has also commenced in which the potential of metal matrix composite material for track shoe applications will be evaluated. This in-house investigation will primarily consist of both wear and impact testing in an attempt to characterize the material before any prototype shoe developments.

LIGHTWEIGHT TOW BAR



- GRAPHITE/EPOXY TUBES WITH KEVLAR OVERWRAP
- REDESIGNED STEEL END FITTINGS
- 62% WEIGHT REDUCTION OVER EXISTING DESIGN

XM975 ROLAND CARRIER

TARADCOM is responsible for the development testing, low-rate initial production including successful fielding of the carrier of the US Roland, all-weather, short-range air defense missile system. The production technical data package (TDP) was finalized and advanced microsets furnished to the low-rate production contractor for computerization of the material call-out. The low-rate production contract was signed in Dec 79. Development started for incorporation of the AN/W-2 passive night drivers sight in the drivers hatch. A ducted engine combustion air induction system with snorkel air intake was developed to correct a DT II/PQT test dificiency. Approximately 500 peculiar drawings for the XM975 were approved. The passive driver's night sight AN/WS-2 installation to the XM975 driver's hatch was developed and tested. PM-Roland will decide incorporation to production vehicles of this user requested sight based on cost impact to program. The engine grill stop was redesignated with an automatic stop to prevent interference with stowed track radar. The protective rear bumper study was terminated by the PM-Roland for cost reasons. Feasibility studies were conducted to incorporate a nuclear, biological and chemical (NBC) collective protection system to the driver's compartment with a purging requirement.

A scope of work, design requirements, preliminary development schedule and an engineering cost estimate (CAT II validated) for FY81 NBC program was prepared. A start work meeting for the NBC collective protection program of the XM975 was held. The facility prototype XM975 carrier was updated to reflect the low-rate production configuration. Delivery of XM975 carriers begins in June 1981. The preliminary TM's (-10, -12, -34P1, -20-1, -20P-1) were prepared and distributed. Incorporation of the hybrid NBC protective system to the US Roland Fire Unit Module requires changes to the low-rate production configuration of the XM975 rear.

TANK-AUTOMOTIVE CONCEPTS LABORATORY

SURVIVABILITY OPTIMIZATION MODEL

The TARADCOM Survivability Optimization Model (SOM) has become operational and is used to evaluate future close combat vehicle concepts. The SOM provides a capability to assess battlefield survivability while a vehicle is still in the concept stage. The model setup and operation costs are lower than the usual combat models, permitting more extensive analysis. The concepts studies so far represent three possibilities for the successor to the XM1: a conventional turreted tank, a casemate tank, and a tank with an elevated gun. The low cost of operation of the SOM permits the characteristics of the concepts to be varied to show improvements and to explore the sensitivity of the results.

ARMORED COMBAT VEHICLE TECHNOLOGY PROGRAM SUPPORT

The Tank-Automotive Concepts Laboratory (TACL) Exploratory Development Division has generated 35 lightweight vehicle concepts in support of the Armored Combat Vehicle Technology Program. Concepts designs were finalized for 25 of these selected by the Armor Engineer Board (AEB).

Design and performance data for these conceptual vehicles were furnished to the AEB, Ballistic Research Laboratory (BRL), TRADOC Systems Analysis Agency (TRASANA) and other agencies. A variety of cannon and missile system weapon stations were configured for these designs. Crew sizes range from two to four and for some concepts the requirement to carry up to three additional persons was met.

Both wheeled and tracked vehicles were studied in weight ranges from 16 to 40 tons.

In many instances new models had to be developed and existing models had to be modified. For example, the mathematical simulation of a tracked vehicle performing a turning maneuver under off-road conditions was developed specifically in support of the Armored Combat Vehicle Technology (ACVT) program. Other models used included the NATO reference mobility model, ride dynamics models, powertrain simulation, vehicle signature model, and firing (platform) stability models. These vehicle concepts are evaluated by means of the mathematical simulations.

The output of these models is used for detailed combat vehicle performance analysis under a variety of conditions. The data will be employed by TRASANA as inputs for force-on-force combat simulation to predict overall military effectiveness.

It is expected that the Concept Laboratory's support will be of considerable worth to the US Army in arriving at the answer to the question raised by the Chief of Staff: "Is a light weight, agile combat vehicle, which is equipped with a rapid fire cannon, a feasible weapon system?"

The ACVT Program's purpose is to establish the technical, military, and economic basis and concept feasiblilty of light weight armored combat vehicles and medium caliber automatic cannons. The Armor Engineer Board (AEB) is the agency responsible for the overall effort. However, TARADCOM has been actively involved in providing extensive support.

TACL has used a gamut of existing computerized mathematical simulations in selecting field tests conditions.

ARMORED COMBAT VEHICLE SCIENCE AND TECHNOLOGY BASE PROGRAM

In recognition of Armored Combat Vehicle Science and Technology (S&T) Program concepts accomplishments, the following tasks were assigned and completed in FY80:

(1) Expansion in the S&T scope beyond tanks to include all combat vehicles in a close combat maneuver unit which are within TARADCOM's mission area.

(2) Defining future combat weapon systems towards which the technology efforts throughout the development community will be focused.

The broadening of scope increased user

representation to include the US Army Infantry Center. Defining future systems and timetables for focusing the technology likewise lengthened the horizon for technology options to 10 and 15 years from now. Results of these major changes will be evidenced in the third edition of the S&T plan which is scheduled to be published in FY81.

The third year of the S&T was characterized by several significant accomplishments in terms of response as well as the structure and scope of the program. During the past year, an increasing impact on the budgeting cycle within headquarters DARCOM resulted from the planning and coordination actions. There is evidence of user reliance on S&T by virtue of committed support to the S&T program and plans.

XM1 PRODUCT IMPROVEMENT PLANNING

The innovative effort to pre-plan product improvement for the XM1 consistent with the "telescoping" philosophy has continued and intensified as production started. This mainly has been accomplished through the Tank Science and Technology Base Development Program.

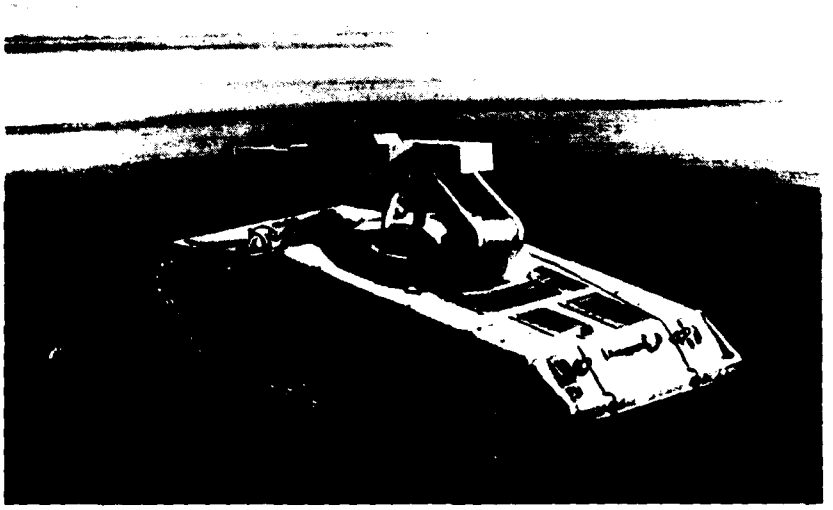
ELEVATED KINETIC ENERGY WEAPON PROGRAM

During FY80, design and fabrication was initiated by the Elevated Kinetic Energy (KE) Weapon Program for the automatic loader, turret controls and drives, stabilization system and the variable height optical sight. A full scale mockup has been built to optimize the turret layout.

The test bed will mount the 75mm automatic cannon. It will have a powered ammunition feed system in which ammunition is conveyed up through an elevator tube to the gun chamber from a storage carousel in the turret. The weapon is stabilized in elevation, and the turret is stabilized in azimuth. The turret controls, drives, and stabilization systems combine components from the XM1, M60 and M551 vehicles.

The Elevated KE Test Bed will allow the development and evaluation of new tactics utilizing defilade positioning and provide a technology base for the assessment of weapon dynamic auto-loaders and fire control requirements of future weapon systems.

The program objective is to design and fabricate a technology demonstrator enabling the evaluation of a combat vehicle processing an elevating KE cannon firing from defilade positions.



Artist Conception of Elevated KE Weapon System

ACOUSTIC SIGNATURE REDUCTION

Acoustic Signature Reduction accomplishments were made in two areas during the current fiscal year.

(1) Reduction of ground combat vehicle track and suspension system acoustic energy emission produced a preliminary design for a "quiet" sprocket to absorb part of the vibration energy imparted to the sprocket by the track before it reaches the vehicle hull which acts as a sounding board. A second generation idler also was designed with a standardized NATO technique for vehicle mobility performance evaluation. In Oct 79, TARADCOM completed a manual which explains the use of the model. In addition, TARADCOM engineers assisted experts of other

NATO participants in implementing the model on national computers.

(2) Experimental engine exhaust quieting systems have been expanded to include heavy combat vehicles. A compact engine exhaust silencing concept has been developed and tested on the M60 tank. The entire system fits in the engine compartment and reduces the nominal distance to detection by 50 percent while idling and 30 percent under full acceleration. No vehicle performance degredation has been noted to date. This silencer concept is being evaluated in conjunction with field tests of acoustic techniques for helicopter detection.

The acoustic energy emitted from operating ground combat vehicle provides a signature which is easily detectable by the human ear and electronic sensors. Reduction of this signature decreases vehicle detection distances and can provide increased vehicle battlefield survivability.

JOINT AIR FORCE-ARMY COUNTERMEASURE EVALUATION PROGRAM

The US Air Force and TARADCOM are cooperating under a Memorandum of Agreement on a program to provide more effective air delivery antitank munitions and vehicles which have a better change of survival against similar adversary threat weapons.

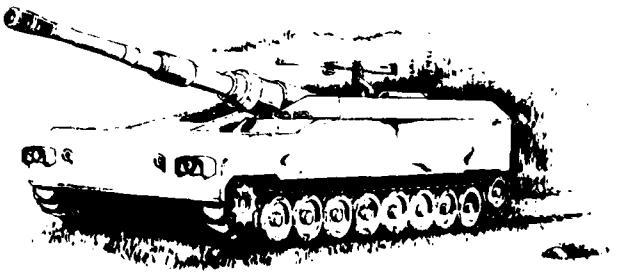
This joint effort has provided TARADCOM with an opportunity to evaluate signature suppression and countermeasure concepts against advanced weapon technology and has helped the Air Force to harden its system against possible enemy countermeasures. Eight joint field tests were conducted.

To date, both radar millimeter wave and infrared countermeasures have been tested and both signature suppression and decoy devices have been employed. Results have been dramatic. In one area, countermeasure and decoy techniques were so successful that further seeker development was abandoned and the Air Force redirected its efforts to an area showing more promise of success.

ENHANCED SELF-PROPELLED ARTILLERY WEAPON SYSTEM SUPPORT

Support provided by TARADCOM to ARRADCOM toward the initial development of a major weapon system called Enhanced Self-Propelled Artillery Weapon System (ESPAWS) includes providing technical and evaluation testing in the automotive chassis and ammunition resupply areas for three concurrent approaches to fulfill the artillery requirements beyond 1990. TARADCOM personnel actively participated throughout FY80 in presentations, meetings, Source Selection Boards, industry design reviews, and trips overseas in relation to the program.

"Quiet" Sprocket



EPAWS Casemate Self Propelled Howitzer Concept

ARMORED FORWARD AREA REARM VEHICLE

The Armored Forward Area Rearm Vehicle (AFARV) program has progressed rapidly during FY80. It is the first vehicle in a family of resupply vehicles to be built on the fully tracked, diesel powered MLRS chassis. The vehicle is designed to resupply ammunition to the Army's M60 and M1 main battle tanks; M2 Infantry Fighting Vehicle; M3, Calvary Fighting Vehicle; and the Improved TOW Vehicle. The AFARV will have handling equipment for the on-loading and off-loading of single rounds and pallets of ammunition. All ammunition resupply actions from the AFARV to the tank can take place with the crew of both vehicles under armor protection. The AFARV is air transportable by C141 or larger cargo aircraft. A full scale mock up of the vehicle, including ammunition pallets and handling equipment, has been completed.

FUTURE VEHICLE SYSTEM

Among concepts developed for incorporation in the XM1 follow-on vehicles are the rearm system, 120mm automatic loader conceptual design, and high survivability modifications. Mobility platforms for air defense systems also were investigated, and the operational effectiveness of wheeled combat vehicle concept was evaluated. A future tank study resulted in concepts which include and externally mounted weapon utilizing advances in surveillance and fire control, propulsion systems, suspension systems, and automatic loading.

IMPROVED INTERIOR LIGHTING FOR GROUND COMBAT VEHICLES THWARTS ENEMY DETECTION

A blue lamp filter for interior blackout security which transmits only visible light was evaluated in the TARADCOM Laboratory and by US combat vehicle crews operating in the field. It was determined that the new light has only a minimal detrimental effect on dark adaptation but provides a significant reduction in the probability or detection by night vision devices. However, it improves crew visual acuity and permits differentiation of colors required for map reading. The removal of the shorter wavelength visible light emission was chosen because the red light which has been used since mid-1940's has minimum effect on the dark adaptation of the eye. The vehicle's interior blackout lighting provides the principle contribution to the detectability. Even though the vehicle interior blackout lighting is barely visible to the human eye at 200 meters, it is of sufficient intensity to saturate in image intensifier such as those employed by modern armies. The bulk of energy emmitted by the incandescent lighting system in US combat vehicles is in the near infrared spectrum and is well within the sensitivity range of Soviet image intensifiers but is beyond the spectral sensitivity limits of the eye.

Armored Forward Area Rearm Vehicle
Artist's Conception

HOLOGRAPHIC VIBRATION ANALYSIS

The laser system, developed by TARADCOM for Holographic Vibration Analysis, is unique because it is very highly tuned (high temporal coherence) and because it uses high power to obtain the necessary illumination.

The equipment and the methodology represent the use of holographic technology for the interpretation of acoustic and structural vibration phenomena.

The laser is pulsed twice within a few hundred microsecond time separations. The vibrating object moves slightly between exposures, giving rise to interference fringes which are superimposed on the photograph. These fringes give detailed information about amplitude and the phase of the object's motion. Knowledge of vibration modes and fringe density data can reveal areas of unusual stress concentrations and potential fatigue-failure.

The Tank-Automotive Laboratory has demonstrated the feasibility of using double pulsed laser holograms for the analysis of the vibrational properties of large structures, such as vehicles.

NATO REFERENCE MOBILITY MODEL

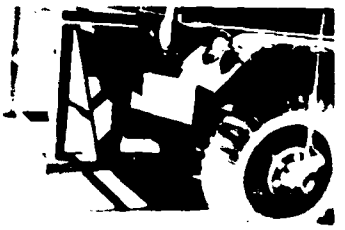
The Army Mobility Model was developed by TARADCOM and the US Army Corps of Engineers Waterways Experiment Station (WES). In Jun 80, NATO Panel II, which is responsible for the standardization of combat and support vehicle, approved the Army Mobility Model as the official NATO Reference Mobility Model (NRMM). It is a comprehensive computerized mathematical simulation of a wheeled or tracked vehicle, which moves off-the-road across a large geographical area. TARADCOM engineers participated in NATO Working Group I which has been appointed to study the Army Mobility Model's suitability to a standardized NATO technique for vehicle mobility performance evaluation. In Oct 79, TARADCOM completed a manual for the model, and assisted other NATO participants in implementing the model on national computers. As a result of TARADCOM's effort, mobility is the first field where a standardized vehicle performance comparison and analysis technique has been agreed upon by NATO. In the future, TARADCOM will serve as the focal point for managing the NRMM.

INTRODUCTION OF THE NATO REFERENCE MOBILITY MODEL INTO THE VEHICLE AND CONCEPT ACQUISITION PROCESS

A further standardized use of the NATO Reference Mobility Model (NRMM) will be in the vehicle acquisition process. In Aug 80, the TARADCOM Commanding General issued a bulletin which states that it is the policy of the Command that Request for Proposal documents and the corresponding bids will utilize the NRMM for specifying and analyzing off-road performance. TARADCOM has initiated the process of familiarizing prospective bidders with the NRMM and is working on developing the task of managing the model to insure that each user has the current version in his possession at all times.

TURNING CHARACTERISTICS OF MILITARY TIRES

In Jun 80, TARADCOM completed a series of field tests which yielded important tire data which has never been measured. New instrumentation and data processing techniques were used to obtain the off-road turning characteristics of military tires. Vertical, longitudinal, and lateral tire forces were measured for a variety of conditions. The measured values are the first set of data available for designers and mobility analysts for the mathematical simulation of off-road agility and turning. The data are expected to enhance TARADCOM's capability to optimize vehicle concepts and to select the best vehicle for a given mission.



Tire Turning Characteristic Test

PRODUCT MANAGER - ARMORED COMBAT VEHICLE TECHNOLOGY

HIGH MOBILITY/AGILITY TEST VEHICLE

The High Mobility/Agility (HIMAG) Test Vehicle Program objective is to produce a variable parameter test bed incorporating a 75mm hypervelocity cannon. The test bed is an experimental assemblage of the most advanced subsystems for combat vehicles that today's technologies can provide. It serves as a mobile laboratory which the Army research and development community, in conjunction with the user, uses to perform tests under field conditions to explore the technical feasibility of these subsystems and their tactical worth on the modern battlefield. Some of the core issues under investigation are:

- Effect of terrain on mobility and agility.
- Effect of agility and mobility on anti-tank missile and gun effectiveness.
- Quantification of relationships among mobility, agility, armor and survivability.
- Capability to achieve acceptable levels of accuracy while firing on-the-move.
- Suitability of 75mm guns for 1990 armor targets.
- Effect of burst-fire on probability hit.
- Human factors considerations to permit optimum use of the high mobility/agility feature.
- Tactical payoff of advanced fire control technology.

Some of the variable parameters are: weight -33.5 to 45 tons; ground pressure - 8.5 to 11.7 psi; HP/Ton - 22.2 to 44.7; horsepower - 1000 to 1500; fire control - six software controlled levels from present M60 to closed loop; number of roadwheels - five or six; number of support rollers - three or four; track - 24-inch aluminum; suspension - variable height, full hydropneumatic, 16 inches in jounce and 6 inches in rebound; gun - 75mm hypervelocity automatic cannon, firing single-shot or up to 6-round burst.

Mobility/agility chassis testing was completed at Fort Knox. Government full-up system testing which includes turret, fire control and the total weapon system, is being conducted and scheduled for completion in Mar 81. Together, these tests will provide a well substantiated data base from which to support decisions on performance characteristics that are technically and economically most appropriate for future generation combat vehicles.

The Fire Control System incorporates a laser rangefinder and a tank thermal nightsight. The HIMAG is powered by a 12-cylinder, air-cooled diesel engine through a X-1100 transmission and modified M51 final drives. The HIMAG uses a 75mm hypervelocity automatic cannon. The acquired data is telemetered from the instrumented test vehicle in real time as the entire data stream is recorded in digital and analog format for subsequent off-line analysis. Additionally, the instrumentation system has a "quick-look" capability to provide on-the-spot data assessment and the tiemly correction of unacceptable inaccuracies. The HIMAG instrumentation system is also considered to be a noted break-through in today's technologies for data collection for tank and automotive systems.

High Mobility/Agility Test Vehicle

HIGH SURVIVABILITY TEST VEHICLE - LIGHTWEIGHT

Three major objectives in the High Survivability Vehicle -Lightweight (HSTV-L) program are: (1) Evaluate the feasibility of utilizing a high-velocity, kinetic energy, medium caliber anti-armor automatic cannon (MC-AAAC) on a light-weight chassis and determine the optimum configuration, (2) determine the best weapon/fire control/chassis combination for offensive and defensive roles and overall system survivability, and (3) determine appropriate actions to be taken by the US Army and USMC regarding the future development of lightweight combat vehicles.

High Survivability Test Vehicle Lightweight

The HSTV-L is a full track, lightweight armored combat test vehicle operated by a three-man crew consisting of the commander, gunner, and driver. The vehicle is powered by a 650-HP gas turbine engine coupled through a special gear box to an X-300 transmission. A fixed hydropneumatic suspension with improved T138 track is used.

The main weapon integrated in the HSTV-L is a cleft turret-mounted 75mm high-velocity automatic cannon. The fire control system has a gunner's primary sight and a hunter sight capable of rotating 360° continuously, independent of turret rotation. Each sight has forward-looking infrared (FLIR) capability. A CO_2 laser rangefinder is integrated into the gunner's primary sight. The fire control system computer provides the appropriate signals to drive the stabilization system. The HSTV-L instrumentation system has the capability to simultaneously record 96 separate data channels.

PROJECT MANAGER FOR IMPROVED TOW VEHICLE

FIRE SUPPORT TEAM VEHICLE

The concept of transitioning the Fire Support Team Vehicle (FISTV) System, as portrayed by the FISTV Transition Plan approved 5 Aug 80, envisions the transfer of the total systems responsibility from PM ITV/FISTV to TACOM in May 1986.

A subcontract for development of a North Seeking Gyrocompass (NSG) for the FISTV was awarded in Apr 80. The FISTV Systems Model has been fabricated and is undergoing a three month Systems Model Test (SMT) 1A with prototype and brassboard hardware. After SMT 1A, the vehicle will be refurbished and upgraded with prototype subsystems for a second test, SMT 1B, which will last for two months. This program is expected to find and correct many problems prior to the engineering design test.

IMPROVED TOW VEHICLE M901

A Transition Plan was approved and signed on 22 October 1979 by the Commanders of both TARADCOM and TARCOM proposing the transfer of the ITV to TACON on 1 Oct 81.

On 25 Jan 80, a multi-year contract for the last 910 M901's was awarded. This will result in a total FY77 - FY82 program of 1982 vehicles and 38 turret trainers with a budget of $263.6 million. Delivery of the last (1982nd) M901 is expected in Aug 82.

Two product improvement programs (PIPs) were initiated by PM-ITV to enhance the M901 capabilities and to keep abreast of improvements of related items. One deals with the TOW Vehicle Power Conditioner (TVPC). Installation of the TVPC in the M901 will allow use of the vehicle electrical system to power the TOW Missile Guidance Set (MGS) thereby increasing reliability and the readiness posture. Application of this kit will be accomplished during the first quarter FY81 on 1982 M901s and 38 Turret Trainers. Another PIP identified as TOW 2 integrated the enhanced capabilities of the Improved TOW missile incorporates an ability to counter electro-optical countermeasures, smoke environment capability and enhance armor piercing capability. Modifications to the M901 are required in the ITV electrical wiring harnesses and stowage. These PIPs will tremendously increase the M901s lethality and survivability.

Action was taken to establish an ADP program designed to extract needed procurement data on all Authorized Stockage List/Prescribed Load List Items.

Depot Maintenance Work Requirements (DMWRS) which provide depot support of the squad leader's periscope, image transfer assembly, launcher and erector arm, cupola and gunner's seat, and the final assembly have been validated adn verified.

Deployment began in Aug 79 and greatly increased during FY80. Emphasis was placed on deployment to Europe first and then CONUS. All deployment is scheduled for completion in Oct 82.

ACTIVITIES

TECHNICAL PAPERS AND PRESENTATIONS

"Activity Report to the Technical Management Committee," by Peter W. Haley, Nov 79, to NATO Reference Mobility Model meeting, at Frankfurt, Germany

"Reduced Order Filter for Linear Discrete-Time Systems with Measurements Containing Colored Noise," "Dynamic Analysis of Articulated M113 APC's," "Dynamic Analysis of High Mobility Tracked Vehicle," co-authored and presented by Dr. Ronald R. Beck, at Eleventh Annual Pittsburgh Conference, School of Engineering, University of Pittsburgh, 2 May 80, Pittsburgh, PA.

"Vehicle Mobility or Firing Stability, a Delicate Balance," presented by Frank Hoogterp and Dr. Ronald R. Beck at the 1980 USA Science Conference, Jun 80, West Point, NY.

"Direct Electronic Fourier Transform Spectra for Surveillance and Countersurveillance," co-authored and presented by Dr. Grant Gerhart, at the Society of Photothermic Instrumentation Engineers (SPIE) meeting, Jul 80, San Diego, CA.

"Holographic Analysis of Large Vehicle Structures," co-authored and presented by Dr. Grant Gerhart, at the 50th Shock and Vibration Symposium, 21 Oct 79, Colorado Springs, CO.

"TARADCOM/KRC Vehicle Signature Model Update" by Dave Wilburn; "Infrared Signature on XM-1 Battle Tank," co-authored by Dave Wilburn and Wallace Mick (presented by Wilburn); "Infrared Signatures of Soviet Armored Combat Vehicles," by Wallace Mick; "Passive Countermeasures to Protect Military Vehicles from Millimeter Wave Seekers," by Gordon McInnes and Dr. John Bennett (presented by Dr. Bennett), at the Second Annual Keweenaw Research Center Ground Vehicle Infrared Signature Symposium, Jul 80, at Houghton, MI.

"The KRC/TARADCOM Ground Infrared Signature Model," co-authored by Dave Wilburn, at meeting of the IRIS Specialty Group on Targets, Backgrounds and Discrimination, Jul 80, at Arlington, VA.

"Engine Research and Development" by Dr. Paul C. Glance, 27-28 Mar 80, ADPA Transport Meeting, Monterey, CA.

"Multifuel Engine Developments" by George E. Cheklich, 17 Oct 79, Army Research Office Emergency Fuels Workshop, Pasadena, CA.

"Advanced Piston Engine Program" by George E. Cheklich, 7 Aug 80, to Mr. R. Standahar, OSD, at TACOM, Warren, MI.

"Tribology Needs in Advanced Diesel Engines" by George E. Cheklich, 5 Aug 80, Army Research Office Workshop on Tribology, Rensselaer Polytechnic Institute, Troy, MI.

"Ceramics for the Adiabatic Turbocompound Engine" by Dr. Walter Bryzik, 10-13 Oct 79, 6th Army Materiels and Mechanics Research Center Materials Technology Conference - Ceramics for High Performance Applications III - Reliability, Orcas Island, WA.

"Adiabatic Turbocompound Engine Performance Prediction" by Dr. Walter Bryzik, Oct 79, Japanese Society of Mechanical Engineers Transactions, Volume 18, No. 225, pages 9-18.

"Engine Research Program of the US Army Tank-Automotive Command" by Dr. Walter Bryzik, 5-7 Jul 80, Workshop on International Combustion sponsored by the Army Research Office, Imperial College, London, England.

"Advanced High Temperature Diesel Engine Research" by Dr. Walter Bryzik, Jul 79, International Engine Combustion Workshop, University of Wisconsin, Madison, WI.

"Multifuel Characteristics of Diesel Engines" by Dr. Walter Bryzik, 17 Oct 79, Fuels Processing Workshop, sponsored by Army Research Office, USC, Pasadena, CA.

"Advanced Techniques for Electrical Power Management, Control, and Distribution Systems (ATEPS)" by Donald S. Sarna and Marquis W. Woody, 30 Oct 79, to Colonel McConnal, Armor and Engineering Board, Ft. Knox, KY.

"ATEPS" by Donald S. Sarna, 19 Feb 80, to General Starry, at TACOM, Warren, MI.

"Simplified Test System Evolution" by Donald S. Sarna, 1 Apr 80, BG Vuono and BG Jolemore, TRADOC, Ft. Monroe, VA.

"Simplified Test System Evolution" by Donald S. Sarna, 2 Apr 80, to DA, Washington, DC.

"Simplified Test Equipment-Expandable (STE-X)" by Donald S. Sarna, 28 May 80, OSD, Washington, DC.

"Improving Land Vehicle Maintenance via Application of Evolving Diagnostic, Prognostic and Electrical Power Distribution Systems Technology" by Donald S. Sarna, 25 Aug 80, to Council of the American Trucking Association at Hyatt Regency, Dearborn, MI

"Track Pin Induced Stress" by S. B. Catalano and S. T. Allen, presented by Catalano, 27-29 Nov 79, to the 28th Defense Conference on Nondestructive Testing, Pensacola Beach, FL.

"Army Engineers Ask the Question: Can Your Trailer Make the Grade?" by Gred Salerno, edited by George J. Bodnar and Jerome T. Cipkowski, published May 80, Trailer Body Builders.

"Tactical Vehicle Fleet - Present and Future" by Roger R. Gay, 27 Mar 80 to American Defense Preparedness Association (ADPA), Monterey, CA.

"Heavy Expanded Mobility Tactical Truck" by Dennis E. Mazurek, 27 Mar 80, to ADPA, Monterey, CA.

"High Mobility Multi-Purpose Wheeled Vehicle" by George J. Bugarin, 27 Mar 80, to ADPA, Monterey, CA.

"Tactical/Missile Trailers" by Roger J. Labataille, 27 Mar 80, to ADPA, Monterey, CA.

"Overview - TARADCOM Engine R&D" by Dr. Paul C. Glance, 27 Mar 80, to ADPA, Monterey, CA.

"Mobility Capability Summary" by COL Herbert H. Dobbs, 10 Sep 80, to ADPA, Ft. Knox, KY.

SEMINAR/COMMITTEE CHAIRMANSHIPS

NATO Reference Mobility Model Technical Management Committee, Nov 79, Frankfurt, Germany (Canada, France, Germany, the Netherlands, United Kingdom, and USA participated). Zoltan J. Janosi, chairman; Peter W. Haley, manager.

Session chairman, 50th Annual Shock and Vibration Symposium, 21 Oct 79, Colorado Springs, CO. Dr. Grant Gerhart.

Session chairman, 26th Conference of Army Mathematicians, Jun 80, on-going assignment at various locations. Dr. James L. Thompson.

PATENT APPLICATIONS FILED (1 Oct 79 - 30 Sep 80)

MEANS FOR SECURING TWO ELEMENTS AGAINST RELATIVE AXIAL MOVEMENT
Ser No 082,398 filed 15 Oct 79
by Erwin F. Geppert

MEANS TO MINIMIZE THE BACKLASH OF MESHING GEARS
Ser No 088,433 filed 26 Oct 79
by Martin J. Neumeyer

BOOM LIFT LOAD RELIEF
Ser No 088,743 filed 26 Oct 79
by James L. Stevens

FIRE SUPPRESSION SYSTEM FOR MILITARY TANKS
Ser No 091,423 filed 5 Nov 79
by Anthony J. Monte

CLOG-PROOF CHECK VALUE
Ser No 091,426 filed 5 Nov 79
by Harold R. Haines

MANUAL OVER-RIDE FOR SHORT STROKE
Ser No 091,425 filed 5 Nov 79
by Edward J. Roznіecki

LINKAGE OF ACTUATING SYSTEM FOR ELEVATING GUN MOUNT
Ser No 095,746 filed 19 Nov 79
by Roland A. Magnuson

GAS GENERATOR ACTUATED FIRE SUPPRESSANT MECHANISM
Ser No 101,327 filed 6 Dec 79
by Karl R. Brofeil

VEHICLE SUSPENSION USING PRESSURIZED BOURDON TUBES
Ser No 101,932 file 10 Dec 79
by Dr. Ernest N. Petrick

MOTOR-DRIVEN WINCH HAVING INTERNAL SPEED REDUCER
Ser No 108,897 filed 31 Dec 79
by Erwin F. Geppert

RESIDUE ACCOMMODATION MEANS FOR A GAS OPERATIONAL GUN
Ser No 108,466 filed 31 Dec 79
by James J. Healy

FIRE SUPPRESSANT IMPACT DIFFUSER
Ser No 111,040 filed 10 Jan 80
by Anthony J. Monte and Ernest C. Wahoski

COMPOSITE CORED COMBAT VEHICLE ARMOR
(A Divisional Application of Ser No 008,315 filed 1 Feb 79)
Ser No 115,639 filed 28 Jan 80
by Anthony J. Monte and Ernest C. Wahoski

GAGE TO MEASURE TRACK TENSION
Ser No 118,136 filed 4 Feb 80
by Boris Zura

DRIVE MECHANISM
Ser No 118,044 filed 4 Feb 80
by Erwin F. Geppert

MECHANISM FOR SELECTIVELY ADJUSTING AMMUNITION FEED CHUTES
Ser No 121,765 filed 15 Feb 80
by Donald N. Montgomery

ELECTROMAGNETIC INTERFERENCE SUPPRESSION IN A VEHICLE HORN CIRCUIT
Ser No 133,173 filed 24 Mar 80
by Christopher B. Mushenski

CABLE GUIDE FOR POWERED WINCH
Ser No 134,860 filed 28 Mar 80
by Roger Smith

VIDEO TRACKER
Ser No 134,858 filed 28 Mar 80
by Donald L. Gay

COMPOSITE LAMINATED VEHICLE ARMOR OF HIGH AND LOW DENSITY METALS
(Continuation - In-Part of Ser No 918,988 filed 26 Jun 78)
Ser No 136,124 filed 31 Mar 80
by Victor H. Pagano and John M. Hennessey

CABINET FOR PATCH PANELS WITH ANALOG COMPUTERS
Ser No 132,358 filed 20 Mar 80
by Donald R. Mentlikowski and James B. Cumbow

MUZZLE POSITION SENSOR
Ser No 148,426 filed 9 May 80
by Donald L. Pairrus and Evert E. Lihtola

BUMPSTOP FOR TRUNNION-MOUNTED WEAPON
Ser No 150,872 filed 19 May 80
by Richard L. Jarvis

MEANS TO MOUNT A COMPONENT ON A DRIVE SHAFT
Ser No 152,920 filed 23 May 80
by Erwin F. Geppert

ARTICULATION JOINT ROLL STABILIZER
Ser No 155,341 filed 2 Jun 80
by Willian T. McCain

MECHANISM FOR REMOVING DUST PARTICLES FROM AN ENGINE AIR CLEANER
Ser No 155,340 filed 2 Jun 80
by Bernard Matthys, Donald Schoen and Carl Anderson

NOISE REDUCTION IN ENGINE EXHAUST
Ser No 159,730 filed 16 Jun 80
by Thomas R. Norris

FABRICATED INDUSTRIAL FASTENER
Ser No 161,187 filed 19 Jun 80
by Peter Gruich

VEHICLE CARGO BOX
Ser No 161,548 filed 20 Jun 80
by Chester J. Taylor and Carl Winkley

LASER SCANNER
Ser No 164,213 filed 30 Jun 80
by Dr. Richard A. Lee

REMOTE CONTROL OF INDUSTRIAL FLUROSCOPES
Ser No 166,722 filed 7 Jul 80
by William A. Moncrief

ADJUSTABLE COMBAT VEHICLE ARMOR
Ser No 168,934 filed 14 Jul 80
by Victor H. Pagano and William J. Seyfert

METHOD OF RECHARGING FIRE EXTINGUISHER BOTTLES
Ser No 170,465 filed 21 Jul 80
by Anthony J. Monte

VARIABLE PRESSURE FUEL INJECTION SYSTEM
Ser No 170,387 filed 21 Jul 80
by Cormac G. O'Neil

ENERGY MANAGEMENT DAMPER
Ser No 171,872 filed 24 Jul 80
by Richard W. Siorek and James P. Theurekauf

FIRE CONTROL MECHANISM
Ser No 189,980 filed 22 Sep 80
by Martin J. Neumeyer, Glenn O'Rourke, Donald J. Carlson and Roger K. Waid

PATENTS ISSUED
1 Oct 79 - 30 Sep 80

Patent No 4,178,832 issued 18 Dec 79
to Robert B. Crowell
for AUTOMATIC GUN HAVING LEAKAGE CONTROL MECHANISM

Patent No 4,179,992 issued 25 Dec 79
to Jawaharlol Ramnarce and William A. Wood
for IMPROVED PRIMER-IGNITER FOR GUN PROPELLANTS

Patent No 4,180,599 issued 25 Dec 79
to Dr. Stephen M. Wolpert and Gustav J. Nerath
for CROSS LINKING PHOTOINITIATORS OF ACRYLIC BENZOPHENONETETRAIBORYLATES

Patent No 4,191,088 issued 4 Mar 80
to Arthur L. Gardiner and Tomas R. Castillo
for LAST ROUND FEED PAWLS

Patent No 4,194,571 issued 25 Mar 80
to Anthony J. Monte
for FIRE SUPPRESSANT MECHANISM FOR MILITARY VEHICLES

Patent No 4,194,304 issued 25 Mar 80
to Lyle A. Wolcott
for LOADER-TRAINER FOR ARTILLERY CREWS

Patent No 4,193,286 issued 18 Mar 80
to Moses R. Garcia
for VEHICLE CONTROL ARM SPREADER TOOL

Patent No 4,183,215 issued 15 Jan 80
to Arthur C. Weber
for PEDAL LINKAGE HYDRAULIC BRAKE BOOSTER

Patent No 4,198,219 issued 15 Apr 80
to William J. Krisko
for AIR INLET GRILLE FOR ENGINE COMPARTMENT

Patent no 4,200,028 issued 29 Apr 80
to William R. Bains
for MULTI-PURPOSE GUN SAFETY

Patent No. 4,219,229 issued 26 Aug 80
to Benjamin Ciocan
for REMOVABLE STANCHION FOR CARGO BRACING PRUPOSES

Patent No 4,203,364 issued Aug 80
to COL Herbert H. Dobbs
for CARTRIDGE FOR REDUCING BONE EROSION AND EXTENDING BARREL LIFE

TECHNICAL REPORTS
CONTRACT AND IN-HOUSE TECHNICAL REPORTS FOR FY 1980

TITLE	REPORT NO.	CONTRACT NO	DATE PUB.
TEMPERATURE PROFILES OF VEHICLES IN DYNAMIC MODES OF OPERATION	12443	DAAK30-77-A-0004	10/79
AIR FLOW TEST AND EVALUATION OF NBC SHIELD CONCEPTS FOR XM1 COMMANDER'S STATION	12452		10/79
DESIGN, TESTING, FABRICATION OF MOLDED NEOTHANE CUSHIONS FOR THE M151, M715, M35A2 AND 800 SERIES 5-TON TRUCKS	12211	DAAE07-75-C-0276	10/79
IMPROVED SEATING FOR MILITARY VEHICLES	12430		10/79
GENERIC COMPONENTS QUALIFICATION FOR DIAGNOSTIC CONNECTOR ASSEMBLIES	12457	DAAK30-77-C-0087 MODIFICATION P00002	10/79
RECAPPED TIRE COMPARISON	12451	DAAK30-78-C-0084	10/79
JOINING STEEL ARMOR INTERMIX	12311		10/79
PRODUCTION METHOD FOR HIGH EFFICIENCY JOINING OF ESR ARMOR	12383		10/79
MILITARY ADAPTATION OF COMMERCIAL ITEMS (MACI) LABORATORY EVALUATION OF CODE E-417 ENGINES	12442		11/79
SURFACE TEMPERATURE PROFILE OF M60 TANK	12454	DAAK39-77-A-0004	11/79
CONFORMANCE OF T-132 TRACK ASSEMBLIES TO PHYSICAL PROPERTY REQUIREMENTS OF SPECIFICATION	12473		11/79
PLATFORM FIRING STABILITY MODEL	12459		11/79
DEVELOPMENT OF LASER WELDING TECHNIQUES FOR JOINING ARMOR	12455	DAAK30-78-C-0118	12/79
PRELIMINARY DESIGN OF THE TRANSITIONAL CONTROLLABLE INTERFACE BOX	12469	DAAE07-76-C-0068	12/79

SIMPLIFIED TEST EQUIPMENT FOR THE IMPROVED TOW VEHICLE	12470	DAAE07-76-C-0068	12/79
AN EVALUATION OF THE TRU-RIDE TIRE SEALANT	12476	DAAK30-77-A-0004	12/79
SURVEILLANCE PLATFORM STABILITY ANALYSIS	12471		12/79
STE/ICE DIAGNOSTIC CONNECTOR ASSEMBLY STANDARDIZATION STUDY REPORT	12382	DAAK30-77-C-0050	1/80
APPLICATION OF SIMPLIFIED TEST EQUIPMENT FOR INTERNAL COMBUSTION ENGINES (STE/ICE) TO THE LANDING VEHICLE TRACKED PERSONNEL (LVTP)-7	12445	DAAK30-77-C-0087	1/80
AN ANALYSIS OF THE TARADCOM ACOUSTIC DETECTION RANGE PREDICTION MODEL	12467	DAAK30-77-A-0004	1/80
BATTLEFIELD EFFECTIVENESS MEASURES FOR SMALL SCALE MODIFICATIONS TO COMBAT VEHICLES	12475		1/80
ANTI-LOCK BRAKING/TRACTION TRANSFER FEASIBILITY STUDY TARADCOM/ AIRESEARCH MEETING	12348	DAAK30-77-C-0095	2/80
EXPLOITATION TEST OF TATRA 813 NBC COLLECTIVE PROTECTION CHARACTERISTICS	12465		3/80
DYNAMIC GUN TUBE BENDING ANALYSIS	12482		3/80
DEVELOPMENT OF AN ADIABATIC DIESEL ENGINE	12448	DAAK30-77-C-0032	4/80
10-TON HIGH MOBILITY TACTICAL TRUCK	12479	DAAK30-77-C-0006	1/80
ELEVATED KE WEAPON TECHNOLOGY STUDY	12486	DAAK30-79-C-0027	4/80
TURBINE ENGINE COMBUSTION RESEARCH	12487	DAAE07-76-C-0063	4/80
TEST AND EVALUATION FOR THE IMPROVEMENT OF SHOCK ABSORBERS FOR THE IFV AND M113 VEHICLES - PHASE II REPORT	12490	DAAK30-78-C-0102	4/80
UNIVERSAL FUEL INJECTION SYSTEM ADAPTATION TO A 4 CYLINDER VHO ENGINE	12466	DAAE07-76-C-0079	4/80
A COMPUTER MODEL FOR AEROSOL SCATTERING OF ELECTROMAGNETIC RADIATION	12472	DAAK30-77-A-0004	4/80
SEMI-AUTOMATIC MAIN ARMAMENT RESPONSE (SMAR)	12494	DAAK-30-78-C-0077	4/80

ARMORED COMBAT VEHICLE TECHNOLOGY STUDY	12495		4/80
COMPUTER ASSISTED TOTAL VALUE ASSESSMENT	12458		4/80
NATO REFERENCE MOBILITY MODEL (Edition 1 - User's Guide Volume 1 and 2)	12503	DAAK30-77-C-0027	5/80
MILITARY ADAPTATION OF COMMERCIAL ITEMS (MACI); LABORATORY EVALUATION OF THE CODE E-419 ENGINE	12488		5/80
ENGINEERING ANALYSIS ON CREW COMPARTMENT HEAT LOAD AND AUXILIARY POWER UNIT PROBLEMS FOR THE M-577/A1 COMMAND POST CARRIER WITH COLECTIVE PROTECTION EQUIPMENT	12497		6/80
DIAGNOSTIC TESTING OF THE XM1 POWER PACK	12492	DAAK30-79-C-0021	6/80
A METHODOLOGY FOR ESTIMATING MISSION RELIABILITY	12512	DAAK30-79-C-0106	7/80
ATEPS CONCEPT APPLICATION TO A GENERIC TACTICAL VEHICLE	12462	DAAK30-78-C-0049	7/80
M113A1 HYDROPNEUMATIC SUSPENSION SYSTEM DURABILITY TEST	12502	DAAK30-79-C-0002	7/80
ENGINEERING DEVELOPMENT AND PRODUCIBILITY ENGINEERING AND PLANNING FOR SIMPLIFIED TEST EQUIPMENT/INTERNAL CIMPUSTION ENGINES (STE/ICE)	12507	DAAE07-76-C-0068	7/80
ATEPS CONCET APPLICATION TO AN ADVANCED SELF-PROPELLED HOWITZER	12460	DAAK30-78-C-0049	7/80
FORMATION AND FAILURE OF ELASTOMER NETWORKS VIA THERMAL, MECHANICAL AND SURFACE CHARACTERIZATION	12498	DAAK30-78-C-0098	7/80
ATEPS IMPLEMENTATION ANALYSIS AND SPECIFICATIONS	12463	DAAK30-78-C-0049	8/80
INFRARED SIGNATURE XM-1, MBT, PILOT 8 (U)	12474		8/80
NBC BREATHING EFFORT TEST OF FILTERED VENTILATING SYSTEM FOR TATRA 813 TRUCK	12480		8/80
EXPLORATORY DEVELOPMENT OF AN ADAPTIVE VIBRATION DAMPER UTILIZING FLUIDIC VALVES	12481	DAAK30-78-C-0113	8/80

650 HP HYDROMECHANICAL TRANSMISSION CONCEPT STUDY	12297	DAAE07-76-C-3259	8/80
DEVELOPMENT OF THE XHM650 HYDROMECHANICAL TRANSMISSION CONCEPT	12296	DAAE07-76-C-3258	8/80
FEASIBILITY STUDY OF ADVANCED VEHICLE SELF-TEST SYSTEMS (BUILT-IN GO/NO-GO INDICATORS)	11654	DAAE07-71-C-0235	9/80
FINAL TECHNICAL REPORT ON PROVISION OF TWO SUNSTRAND DMT 250-24 TRANSMISSIONS FOR DYNAMOMETER AND VEHICLE TEST WITH LICT-350 AND LICT-525 VHO ENGINES	11674	DAAE07-71-C-0189	9/80
EVALUATION OF PERFORMANCE AND DURABILITY OF THE M817 5-TON TRUCK	11689	DA-20-113-AMC-11625-(T)	9/80
INSTALLATION OF LDS-465-1A (MODIFIED) ENGINE IN AN M35A1 VEHICLE WITH A BORG-WARNER AUTOMATIC TRANSMISSION FOR ENDURANCE AND DURABILITY EVALUATION OF THE AUTOMTATIC TRANSMISSION PACKAGE	11690	DA-20-113-AMC-11625 (T)	9/80
DEVELOPMENT, ANALYSIS, AND TESTING OF CANDIDATE DESIGNS FOR IMPROVED, TANK FLOOR PROTECTION AGAINST MINE BLAST	12523	DAAK30-79-C-0064 MOD. #1	9/80
FIELD EXPEDIENT INFRARED COUNTERMEASURES AND TACTICS FOR ARMORED VEHICLES	12505		9/80
RAM INVESTIGATION OF SOVIET JEEP DESIGN RIVIEW: UAZ-469	12484		9/80
FEASIBILITY STUDY OF APPLICATION OF ELECTROSTATIC DUST PRECIPITATION TO AUTOMOTIVE GAS TURBINE POWER PLANT	11516	DAAE07-68-C-2901	9/80
SYSTEM REQUIRMENTS FOR AUTOMOTIVE TEST SET FOR DIRECT SUPPORT/GENERAL SUPPORT	11712	DAAE07-72-C-0340	9/80
M113A1 HYDROPNEUMATIC SUSPENSION SYSTEM DURABILITY TEST	12502	DAAK30-79-C-0002	7/80
MANUFACTURE OF FLAT, LIGHT-GAGE ALLOY STEEL ARMOR PLATE	12532	DAAK30-78-C-0128	

DEVELOPMENT, ANALYSIS AND TESTING OF CANDIDATE DESIGNS FOR IMPROVED TANK FLOOR PROTECTION AGAINST MINE-BLAST	12523	DAAK30-79-C-0064	8/80
ARMOR DESIGN FOR PROTECTION AGAINST SHELL FRAGMENTS	12526	DAAK30-79-C-0059	8/80
RESEARCH ON FIRE CONTROL CONCEPTS FOR MANEUVERING TARGETS	12511	DAAK30-79-C-0104	7/80
DYNAMIC GUN TUBE BENDING ANALYSIS	12482		1/80
ROTATIONAL MOLDING OF LARGE CAPACITY FUEL TANKS FOR COMBAT VEHICLES	12529		7/80
TEST OF BONDED BRAKE LINING ON FABRICATED WELDED BRAKE SHOES	12516		5/80
BRAKE LINING WEAR INDICATORS	12515		5/80
FINAL LETTER REPORT - FEASIBILITY TEST OF BATTERY SLAVE CABLES AND RECEPTACLES (12 VOLT) FOR COMMERCIAL VEHICLES		1-VG-123-000-011	8/80
ELECTRICAL HEATED WINDSHIELD DEFROST SYSTEM PERFORMANCE EVALUATION			5/80
APPLICATION OF FINITE ELEMENT ANALYSIS TO COMBAT AND TACTICAL VEHICLES AND COMPONENTS	12478		3/80

FACILITIES

OVERVIEW

The U.S. Army Tank-Automotive R&D Command Laboratories and shops are equipped to develop and support the military vehicle fleet. Research and study are performed here on propulsion systems, surface mobility systems, vehicular components, and materials – from concept through prototype. Replacement cost of these facilities in today's dollars is $158,000,000.

PHYSICAL SCIENCE LAB

The lab has facilities for extensive investigations into vehicle signatures and signature reduction methods. Non-destructive test capabilities include holographic analysis. Mini-computers and remote terminals provide a ready capability for engineering analysis, modeling, and simulation studies.

PROPULSION SYSTEMS LAB

Present facilities include nine test cells. Three are vehicle or transmission cells and six are for engines. One cell is equipped with a semi-anechoic chamber. Cell 9 is equipped for tracked or wheeled vehicle tests under temperatures up to 160°F, solar radiation simulation, and winds up to 20 mph.

TRACK AND SUSPENSION LAB

One of the outstanding features of this laboratory is its dynamic simulation capability. Vibration and shock imputs from terrain tapes are fed through hydraulic actuators to the tires, wheel spindles or roadwheel arms. The simulation approaches permit accelerated testing of vehicles and components so that designs can be optimized without time consuming field testing. Smaller actuators accommodate fatigue tests on components and subsystems.

EXPERIMENTAL FABRICATION

The facility includes sheet metal, welding, machining equipment capable of fabricating steel or aluminum hulls and turrets. The assembly area has high bays and cranes to handle vehicles up to 60 tons. The experimental foundry, model and pattern shop, heat treating, plating and painting equipment complete the fabrication complex.

ELECTRO-MECHANICAL SYSTEMS

Additional facilities permit test of engine accessories – including tank air cleaners, electrical components, and mechanical and hydraulic subsystems.

KEWEENAW FIELD STATION

The Keweenaw Field Station is located at Houghton, MI and consists of vehicle maintenance shops, small machine shop storage, and office buildings; it houses a wide variety of support vehicles and equipment for R&D field testing. The station is managed by the Keweenaw Research Center of the Michigan Technological University and is used for a wide variety of R&D work as well as related field tests in support of TARADCOM's mission.

Edited and coordinated
by Richard C. Stark,
Project Officer for
the Posture Report

Suggestions to improve the report are welcome. Requests for copies may be addressed to Technical Library Office, DRSTA-TS, U.S. Army Tank-Automotive Command, Warren, Michigan, 48090.


N
DATE